PB-216 942

LAKE ERIE REPORT. A PLAN FOR WATER POLLUTION

Federal Water Pollution Control Administration
Chicago, Illinois

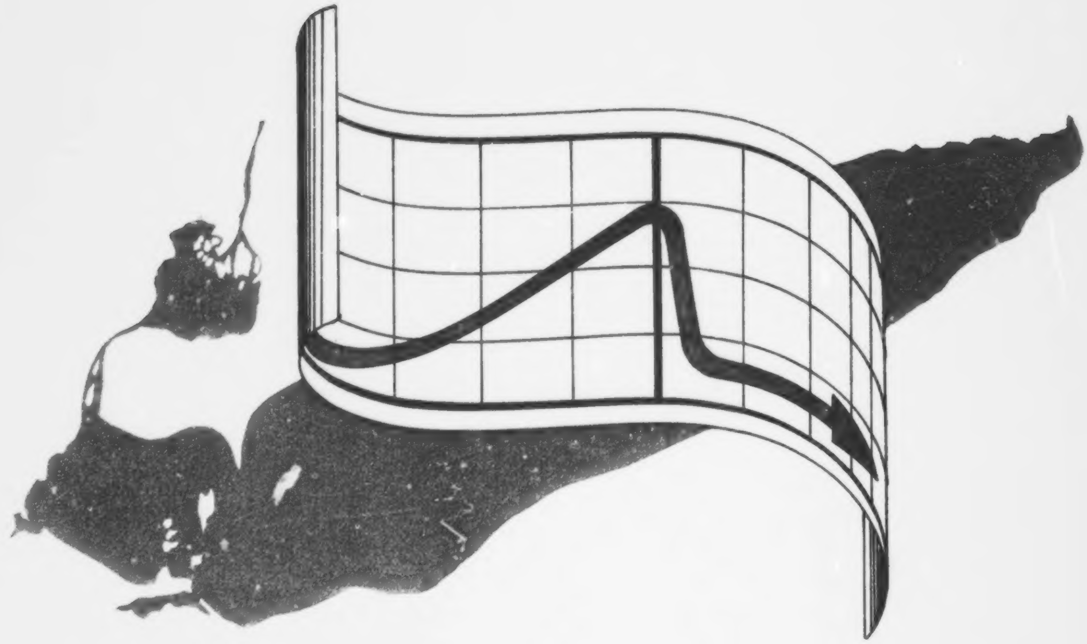
August 1968

DISTRIBUTED BY:

NTIS
National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 216 942

LAKE ERIE REPORT



A PLAN FOR WATER POLLUTION CONTROL

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION

AUGUST 1968

113

"....we must act, and act swiftly. The hour is late, the damage is large.

The clear, fresh waters that were our national heritage have become dumping grounds for garbage and filth. They poison our fish, they breed disease, they despoil our landscapes.

.....This sort of carelessness and selfishness ought to be stopped; and more, it just must be reversed. And we are going to reverse it."

Lyndon B. Johnson
upon signing the Water Quality Act of 1965

LAKE ERIE REPORT

A PLAN FOR WATER POLLUTION CONTROL

August 1968

Details of illustrations in this
document may be better studied
on microfiche.

United States
Department of Interior
Federal Water Pollution Control Administration
Great Lakes Region

FOREWORD

Man is destroying Lake Erie. Although the accelerating destruction process has been inadvertent, it is as positive as if he had put all his energies into devising and implementing the means. After two generations the process has gained a momentum which now requires a monumental effort to retard. The effort must not only be basin-wide and highly coordinated; it must be immediate. Every moment lost in allowing the destruction to continue will require a longer, more difficult, and more expensive corrective action.

Fortunately, although Lake Erie is the most sensitive of the Great Lakes to waste inputs, it is also the most amenable to corrective measures because of its relatively small volume, rapid flushout time, and the high volume input of excellent quality Lake Huron water. Lake Erie's total response to cleanup, beginning now, will thus be measured in years or tens of years while the other lakes might require hundreds of years.

The cleanup of Lake Erie is less a problem of engineering than it is a problem of diverse, inadequate, and unwieldy changing governmental policies, funding, and management. The technical engineering methods of waste control are known or close at hand with the main requirement being only their coordinated application. As an international and an interstate body of water, management involves two national governments, five state governments, one provincial government, and a multitude of local governments. Primary responsibility for pollution control lies at the state and provincial level.

The overall Great Lakes pollution problem was ackowledged in 1960 when funds were appropriated, under authorization of the Federal Water Pollution Control Act of 1956, for a comprehensive study of the Great Lakes. The study was undertaken by the Division of Water Supply and Pollution Control of the U. S. Public Health Service. The Lake Erie portion of the study began in 1963. The Water Quality Act of 1965 transferred responsibility for the studies to the newly formed Federal Water Pollution Control Administration which a short time later was transferred to the Department of the Interior.

Federal involvement in the Great Lakes pollution control effort led to several significant actions concerning Lake Erie. In 1962 at the request of the Governor of Michigan, a Federal Enforcement Conference convened to identify actions needed to abate serious pollution in Michigan's waters of the basin. In 1965, at the request of the Governor of Ohio, another Federal Enforcement Conference was held, with all five states of the basin represented, to make recommendations and adopt schedules for abatement of waste discharges to the United States portion of the basin. The recommendations were approved by the Secretary of the Interior.

The Water Quality Act of 1965 gave new urgency and support to the cooperative work already underway. The establishment of interstate water quality standards was required by the Act. These standards, a joint effort by the States and the Federal government, constitute a focal point for even greater effort. The 1966 Clean Water Restoration amendments invited the States to adopt the same policy of standards to intrastate waters and all Lake Erie States are doing so. These amendments also called for much larger Federal expenditures in pollution control.

Pollution control programs in the Lake Erie basin must be directed, in the years ahead, to the achievement of these standards and to the fulfillment of the agreements of the two enforcement conferences. In addition, programs should be directed to even further measures needed for the cleanup of intrastate streams, reduction of nutrients, consolidation of waste water treatment plants, and strengthening of State participation as outlined in this report. Success in these efforts will require strong public support and continuing overall direction and coordination of the vast array of pollution abatement machinery by the Federal government.

This report recommends a plan of action, combining immediate and long-range needs. It describes the pollution problem and the ominous threat of continued pollution. It also describes what must be done to save Lake Erie, who will take these actions, and how much it will cost. It remains for the citizens of the basin to act quickly, decisively, and wholeheartedly.

Joe G. Moore, Jr.

JOE G. MOORE, JR., *Commissioner*
Federal Water Pollution Control Administration
U.S. Department of the Interior

TABLE OF CONTENTS

Page

FOREWORD

CONCLUSIONS 1

RECOMMENDATIONS 11

CHAPTER 1 – THE BASIN AND ITS FEATURES 17
  General Description 17
  Hydrology 21

CHAPTER 2 – THE DEMAND FOR WATER 27
  Population 27
  Industry 27
  Agriculture 28
  Tourism and Recreation 28
  Fish and Wildlife 29
  Commercial Shipping 30

CHAPTER 3 – THE POLLUTION PROBLEM 31
  Lake Problems 31
  Tributary Problems 37
    Southeast Michigan Area 37
    Maumee River Basin 40
    North Central Ohio Area 43
    Greater Cleveland-Akron Area 45
    Northeast Ohio Area 48
    Pennsylvania Area 48
    New York Area 50

CHAPTER 4 – THE CAUSE OF POLLUTION 53
  Waste Sources 53
  Constituents in Wastes 59

CHAPTER 5 – WATER POLLUTION CONTROL NEEDS 67
  Enforcement 67
  Water Quality Standards 71
  Municipal and Industrial Waste Treatment Needs 72
  Other Needs 79

CHAPTER 6 – THE COST OF POLLUTION CONTROL 83
  Municipal Waste Treatment Costs 83
  Industrial Waste Treatment Costs 86

APPENDIX 87

LIST OF FIGURES

Figure		Page
1	Population Projection for Lake Erie Basin	1
2	Projected Phosphorus Waste Within Lake Erie Basin	2
3	Polluted Beach Areas in Lake Erie	3
4	Rise in Lake Erie Chloride Content since 1900	4
5	Areas of Primary Responsibility for Pollution of Lake Erie	4
6	Heavily Polluted Tributaries to Lake Erie	6
7	Ten Largest Sources of Municipal Wastes in U. S. Portion of Lake Erie Basin	7
8	Twenty Major U. S. Industrial Water Users in Lake Erie Basin	8
1-1	Lake Erie Basin	18
1-2	Lake Erie Bottom Topography	19
1-3	Bottom Deposits in Lake Erie	19
1-4	Dominant Summer Surface Flow Pattern in Lake Erie	20
1-5	Dominant Summer Bottom Flow Pattern in Lake Erie	20
1-6	Precipitation in Lake Erie Basin	22
1-7	Comparative Water Inputs of Important Tributaries to Lake Erie	23
1-8	Monthly Tributary Flows to Lake Erie from St. Clair, Maumee, and Cuyahoga Rivers	24
1-9	Lake Erie Basin Ground Water Availability	24
1-10	Lake Erie Basin Ground Water Quality	25
2-1	Population Projection	27
2-2	Projected Municipal Water Use	28
2-3	Projected Industrial Water Use	28
2-4	Recreation Areas in Lake Erie Basin	29
3-1	Hypothetical Rates of Aging	32
3-2	Aging Indicators	32
3-3	Phytoplankton Abundance at Cleveland Water Intake	33
3-4	Changes in Chemical Characteristics of Lake Erie	33
3-5	Decline of Desirable Fish in Lake Erie (5 Year Running Averages)	33
3-6	Sludgeworms-Western Basin Lake Erie	34
3-7	Lake Erie Dissolved Oxygen Bottom Water – August 1964	34
3-8	Lake Erie Bathing Beach Water Quality Situation	36

LIST OF FIGURES

Figure		Page
3-9	Southeast Michigan Area Water Quality Situation	38
3-10	Maumee River Basin Water Quality Situation	41
3-11	North Central Ohio Area Water Quality Situation	44
3-12	Greater Cleveland-Akron Area Water Quality Situation	46
3-13	Northeastern Ohio Area Water Quality Situation	49
3-14	New York Area Water Quality Situation	51
4-1	1960 Municipal Sewage Treatment Plant Data by Subbasin	54
4-2	1960 Industrial Discharges by Subbasin	54
4-3	Lake Erie Basin Total Projected Daily BOD Load and Effect of Reduction-Industrial and Municipal Sources	60
4-4	Present and Projected BOD Load Discharged in the Lake Erie Basin	61
4-5	Present and Projected Chloride Discharges in the Lake Erie Basin Without Additional Controls	62
4-6	Projected Chloride Load to Lake Erie and Loads with Various In-Basin Load Reductions	62
4-7	Present and Projected Phosphorus Discharges in the Lake Erie Basin without Additional Control	64
4-8	Projected Phosphorus Load to Lake Erie by Source-Cumulative	64
5-1	Southeast Michigan Area Proposed Interceptors	73
5-2	Southeast Michigan Area Major Municipal and Industrial Waste Treatment Needs	74
5-3	Maumee River Basin and North Central Ohio Area Major Municipal and Industrial Waste Treatment Needs	76
5-4	Greater Cleveland-Akron and Northeastern Ohio Areas Major Municipal and Industrial Waste Treatment Needs	78
5-5	Pennsylvanvia and New York Areas Major Municipal and Industrial Waste Treatment Needs	80
6-1	Noncumulative Annual Treatment Costs through 1989	84
6-2	Construction Costs for FWPCA Recommended Municipal Immediate Needs	85
6-3	Construction Costs for FWPCA Recommended Industrial Immediate Needs	85

LIST OF TABLES

Table		Page
1	Waste Discharges to Tributaries in Lake Erie Basin	5
1-1	Estimated Water Balance in Lake Erie	22
1-2	Runoff Statistics for Tributaries of the Lake Erie Basin	23
3-1	Water Quality of Lake Erie Bathing Beaches	37
4-1	Percent Waste Contribution of Major Source Areas in Lake Erie Basin	53
4-2	Ten Largest U. S. Sources of Municipal Waste in Lake Erie Drainage Basin	53
4-3	Municipal Treatment Plant Waste Discharges in Population Equivalents	55
4-4	Industrial Waste Source Classification	55
4-5	Twenty Largest U. S. Producers of Industrial Waste Water in Lake Erie Drainage Basin	56
4-6	Projected BOD in lbs/day from Storm Water Overflows Assuming no Further Control Measures or Separation of Existing Sewers	57
4-7	Projected BOD lbs/day Storm Water Overflow Assuming Separate Sewer Systems Throughout	57
4-8	1967 Estimated Harbor Dredging Spoil Dumped in Lake Erie	58
4-9	Waste Loads to Lake Erie Basin Waters	60
4-10	Present Untreated Municipal and Industrial BOD Loads by Subbasin	61
4-11	Present and Projected Phosphorus Discharges to Lake Erie Exclusive of Lake Huron Input	63
5-1	Summary of Water Pollution Control Needs	67
A-1	Southeast Michigan Area Major Municipal Waste Problems	87
A-2	Southeast Michigan Area Major Industrial Waste Problems	89
A-3	Maumee River and North Central Ohio Area Major Municipal Waste Problems	92
A-4	Maumee River and North Central Ohio Area Major Industrial Waste Problems	96
A-5	Greater Cleveland-Akron and Northeast Ohio Areas Major Municipal Waste Problems	99
A-6	Greater Cleveland-Akron and Northeast Ohio Areas Major Industrial Waste Problems	101
A-7	Pennsylvania and New York Areas Major Municipal Waste Problems	104
A-8	Pennsylvania and New York Areas Major Industrial Waste Problems	106

CONCLUSIONS

1. *Lake Erie is the economic lifeblood* of over 13 million persons, a priceless national heritage whose quality must be maintained and enhanced and passed on to future generations in a condition of unlimited usefulness.

2. *The U.S. population* in the Lake Erie basin stands at 11.5 million. Another 1.5 million persons live on the Canadian side of the lake. The total population is expected to swell to 18 million persons by 1990 (Figure 1), increasing the need for more and better waste control. Industrial growth in the Lake Erie basin parallels the population growth. The current annual value added by manufacturing to the basin's economy stands at more than $17 billion.

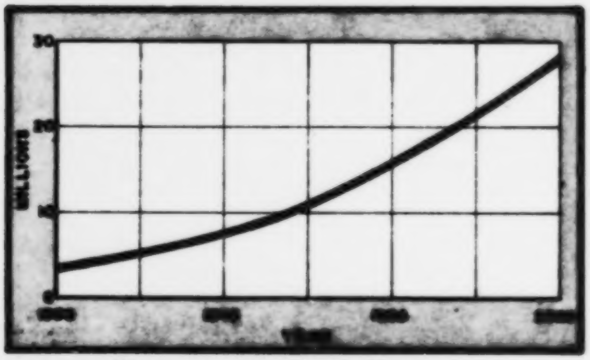


Figure 1 – Population Projection for the Lake Erie Basin

3. *The major water uses of Lake Erie are* as follows:

   a. Water Supply – Municipalities use 1.5 billion gallons per day with 44% being taken directly from the lake, 38% from the Detroit River, and 18% from inland sources. Industries use 9.6 billion gallons per day withdrawing 46% of this from the lake, 44% from the Detroit and St. Clair Rivers, and 10% from inland sources.

   b. Recreation – Recreation in the form of swimming, water skiing, boating, and sport fishing is a major industry, and the lake itself is the main attraction. During 1963, 75 million visits were made to the 170 federal, state, and local parks in the basin.

   c. Commercial Fishing – The value of commercial fish caught in Lake Erie has rapidly declined because of the absence of the high quality fish in recent years, but the total poundage of fish caught has remained relatively steady, averaging approximately 50 million pounds annually through 1966.

   d. Commercial Shipping – In 1965 trade at major ports was 141 million tons of cargo.

4. *Many years of neglect by the citizens and governments of the basin and lack of knowledge* concerning the dynamics of lake ecology and causes of lake pollution are the principal reasons Lake Erie has a major pollution problem. For it is, in the final analysis, the actions of commission or omission by the people and the governments in the Lake Erie basin as guardians of its water resources, which have placed those resources in their present condition. It is equally true that Lake Erie can be restored to its one-time health and usefulness only

Algae produced by Lake Erie's overenrichment with nutrients clog the basin's beaches, produce taste and odors in domestic water supplies, and deplete the lake's lower waters of oxygen.

if the basin governments, with support from the people, establish the public policies and governmental institutions capable for doing so. At the present time there is inadequate treatment due to insufficient financing, research, surveillance, and enforcement by the basin governments.

5. *Lake Erie is overenriched* with nutrients from pollution. The overenrichment is causing premature aging, evident in the following aspects:

a. Depletion of the life-sustaining oxygen in the bottom of the lake each summer.

b. Replacement of high quality fish with scavenger-type fish.

c. Undesirable tastes and odors in water supplied, caused by algae.

d. Littering of shoreline with rotting and foul-smelling masses of algae.

e. Increase in the number of pollution-indicating algae.

f. Increase in the concentration of chemicals in the lake.

6. *Phosphorus*, because it is the one essential nutrient for which control measures are best known, is easily singled out as the key to control of overfertilization and premature aging of Lake Erie. The phosphorus contribution of 137,000 lbs/day from sources within the Lake Erie basin is composed of 72% from municipal wastes, 17% from rural runoff, 4% from industrial wastes, and 7% from urban runoff. In municipal wastes, 66% comes from detergents. If the total phosphorus discharges continue unchecked, the phosphorus load is expected to increase to 227,000 lbs/day by 1990 (Figure 2).

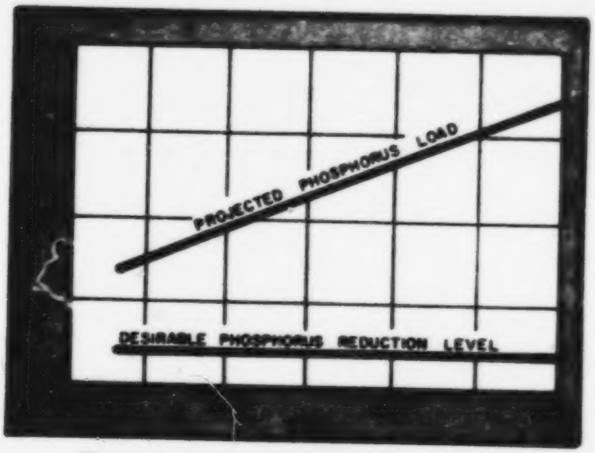


Figure 2 – Projected Phosphorus Waste Within the Lake Erie Basin

7. Reducing the total phosphorus discharge from all in-basin sources to 40,000 lbs/day should control algal growths and arrest the aging process in Lake Erie. In order to accomplish this level of reduction it will be necessary to reduce the discharge of total phosphorus from municipal and industrial wastes to 9,000 lbs/day.

8. *Bacterial pollution of Lake Erie* and its tributaries is evident in the number of unsafe bathing beaches and the undesirable condition of a few water supplies. Polluted bathing beaches in the summer of 1967 (Figure 3) were as follows:

Michigan – Sterling State Park

Ohio – Toledo area beaches, Century Park, Sheffield Lake Park, Avon Lake Park, Rocky River Park, Perkins Beach, Edgewater Park, White City, Euclid, Wildwood, and Lloyd Road

Pennsylvania – Beach 11 at Presque Isle and Waldemeer

New York – Silver Creek, Westfield, and Hamburg Town Park, Ripley, Lake Erie State Park, Point Gratiot, Wright, Sheridan Bay, Hanover Beach, and Sunset Bay

Other public beaches as well as the deep open waters of the lake are always or usually safe for swimming.

UNSAFE
FOR
SWIMMING

Many bathing beaches are now closed temporarily or permanently. Combined sewers, storm water overflows, and inadequately treated sewage have been the main source of pollution.

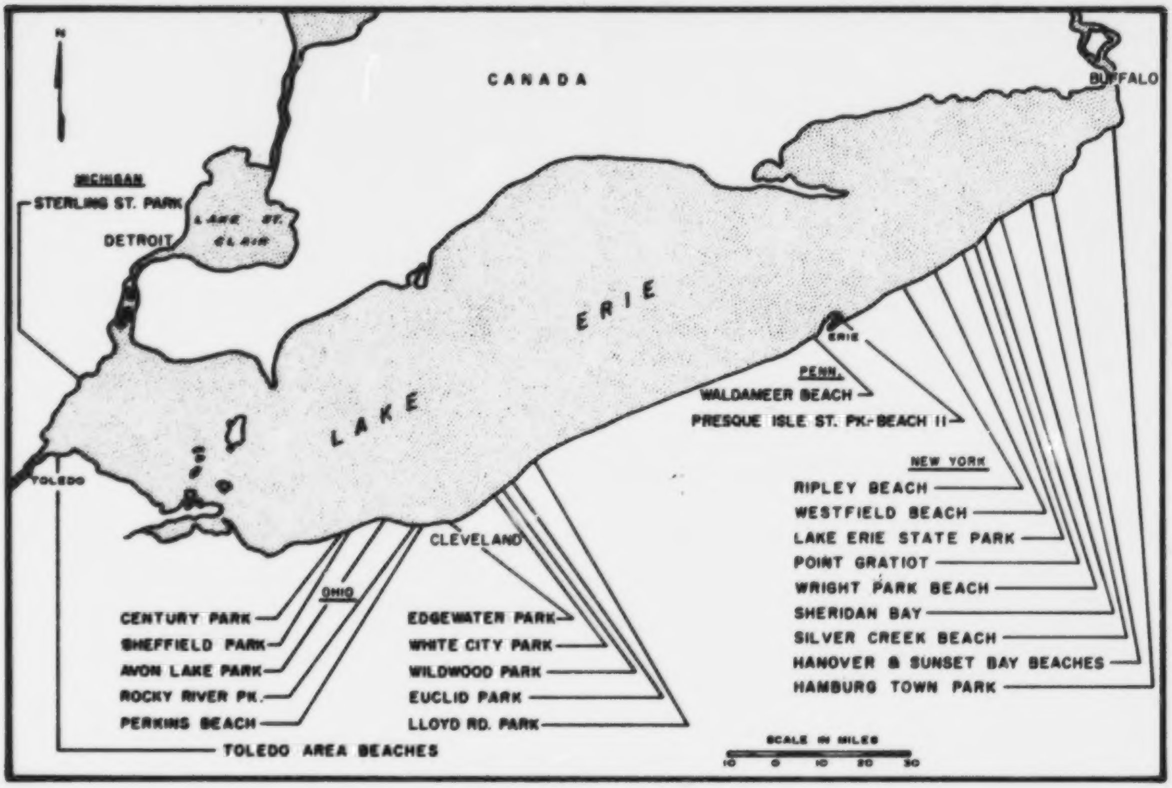
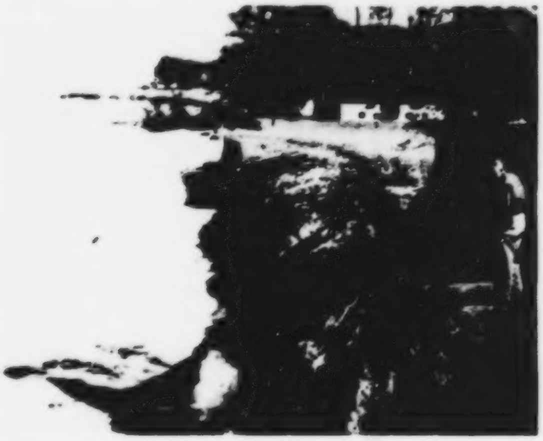

N
CANADA
BUFFALO
MICHIGAN
STERLING ST. PARK
DETROIT
LAKE ST. CLAIR
LAKE ERIE
ERIE
PENN.
WALDAMEER BEACH
PRESQUE ISLE ST. PK-BEACH 11
NEW YORK
RIPLEY BEACH
WESTFIELD BEACH
LAKE ERIE STATE PARK
POINT GRATIOT
WRIGHT PARK BEACH
SHERIDAN BAY
SILVER CREEK BEACH
HANOVER & SUNSET BAY BEACHES
HAMBURG TOWN PARK
TOLEDO
CLEVELAND
OHIO
CENTURY PARK
SHEFFIELD PARK
AVON LAKE PARK
ROCKY RIVER PK.
PERKINS BEACH
EDGEWATER PARK
WHITE CITY PARK
WILDWOOD PARK
EUCLID PARK
LLOYD RD. PARK
TOLEDO AREA BEACHES
SCALE IN MILES
10 0 10 20 30

Figure 3 – Polluted Beach Areas in Lake Erie

9. *Lake Erie is used as a silt dump.* Siltation of Lake Erie from land runoff is a local problem in harbors where it causes severe discoloration and a need for frequent dredging. To a lesser extent, in the western basin, siltation tends to at least occasionally cover coarser sediments and rock which are the spawning areas for many fishes. About 33 million tons of sediment reach the lake each year with almost one-half of this coming from lakeshore erosion. In many tributaries, especially the Maumee River, siltation is a major pollution factor. One of the principal concerns regarding the silt load to the lake is the amount of nutrients contained within the silt.



Millions of tons of silt yearly are wasted to the lake by shore erosion.

10. *Fifteen harbors are dredged* periodically along the United States shore of the Lake Erie basin by the U.S. Army, Corps of Engineers, to maintain navigation channel depths. In most harbors the removed material is a combination of silt and municipal and industrial wastes, amounting to some nine million tons annually in the Erie basin, over one-fourth of the total silt load to Lake Erie. In many cases the wastes harm lake water quality by the addition of oxygen-consuming substances and nutrients. It has been the policy to dump the dredged materials in the lake within a few miles of the dredging sites which may be transferring highly polluted substances to relatively unpolluted areas. A cooperative study between FWPCA and the Corps of Engineers is in progress to find and develop suitable alternate means of disposal other than open dumping in Lake Erie.

11. *Concentrations of chemicals in Lake Erie are rising.* Dissolved solids have increased from 140 mg/1 at the turn of the century to a present level of 197 mg/1. The changing pattern of chlorides (Figure 4) is also a good indication that the concentrations of chemicals in Lake Erie are rising. Historical data indicate that the concentration of chlorides in Lake Erie was 7 mg/1 at the

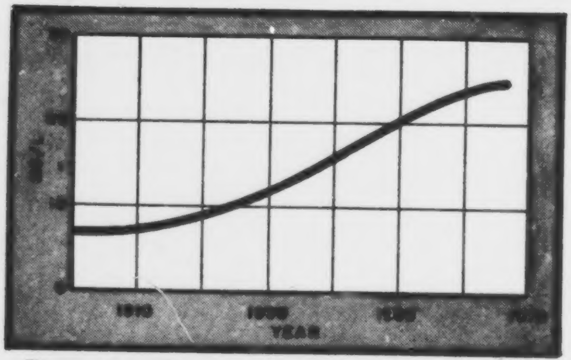


Figure 4 – Rise In Lake Erie Chloride Content Since 1900

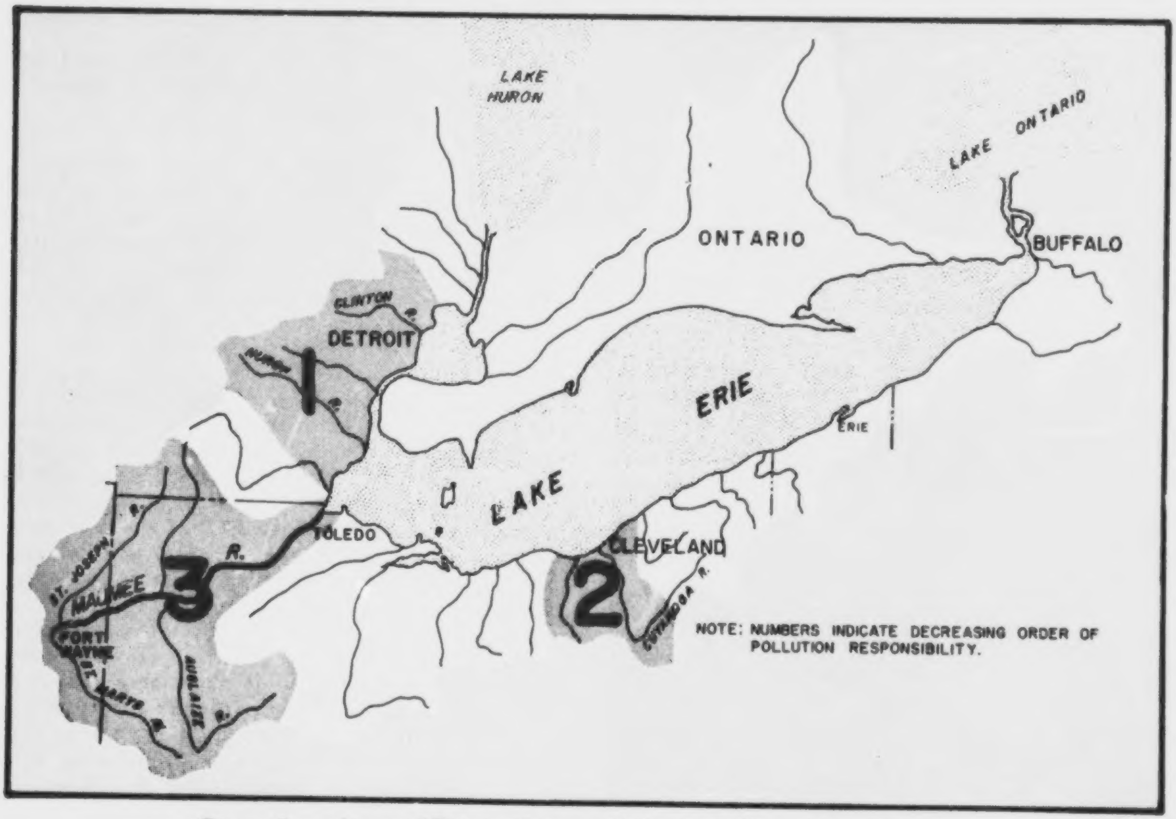
beginning of this century. At that time a noticeable increase began, and in 60 years the concentration has more than tripled. Industrial wastes account for 43% of the chloride load to Lake Erie, the Lake Huron input 26%, municipal wastes 7%, and street deicing 12%. Another 12% is derived from undifferentiated Canadian sources.

12. *Three geographical areas are primarily responsible* for the present polluted condition of Lake Erie (Figure 5). These areas in order of decreasing effect on the overall quality of Lake Erie water are (1) Detroit, Michigan, and its surrounding municipalities, (2) the Greater Cleveland-Akron area, and (3) the Maumee River basin area.

Mouth of Rouge River. Oil slicks, iron, and inadequately treated sewage.

13. *Most of the tributaries are polluted* to the extent that many uses of the water are inhibited or nonexistent. The primary pollution problem in the tributaries is lack of dissolved oxygen caused by the discharge of inadequately treated municipal wastes and certain industrial wastes.

The heavily polluted tributaries (Figure 6) are listed in Table I along with the major sources of wastes.


LAKE HURON
LAKE ONTARIO
ONTARIO
BUFFALO
CLINTON R.
DETROIT
HURON R.
1
ERIE
LAKE ERIE
TOLEDO
CLEVELAND
CUYAHOGA R.
2
ST. JOSEPH R.
MAUMEE R.
3
FORT WAYNE
ST. MARYS R.
AUGLAIZE R.

NOTE: NUMBERS INDICATE DECREASING ORDER OF POLLUTION RESPONSIBILITY.

Figure 5 – Areas of Primary Responsibility for Pollution of Lake Erie

TABLE I – WASTE DISCHARGES TO TRIBUTARIES IN LAKE ERIE BASIN

TRIBUTARY	MAJOR POLLUTION SOURCES	
	Municipal	Industrial
Michigan		
Clinton R.	Pontiac, Utica, Rochester, Mt. Clemens, Warren, Fraser, Sterling Twp., Harrison Twp.	
Rouge R.	Detroit	Ford, Scott Paper
Detroit R.	Detroit, Wyandotte, Riverview, Trenton, Grosse Ile, Wayne County	Great Lakes Steel, Allied Chemical, McLouth Steel, Pennsalt Chemical, Wyandotte Chemical, Mobil Oil, Monsanto Chemical, Firestone Rubber, Revere Copper & Brass
Huron R.	Ann Arbor, Ypsilanti, Ypsilanti Twp., Flat Rock	Ford, General Motors
Raisin R.	Monroe	Consolidated Packaging, Time Container, Union Bag-Camp, Ford
Indiana		
Upper Maumee R.	Ft. Wayne	
Ohio		
Lower Maumee R.	Toledo	
Auglaize R.	Lima, Findlay	Sohio
Portage R.	Bowling Green, Fostoria	
Sandusky R.	Bucyrus, Upper Sandusky, Tiffin, Fremont	
Lower Black R.	Elyria, Lorain	U.S. Steel, Republic Steel
Rocky R.	Berea, North Olmsted, Lakewood	
Upper Cuyahoga R.	Akron	Goodyear, B.F. Goodrich, Firestone
Lower Cuyahoga R.	Cleveland	U.S. Steel, Republic Steel, Jones and Laughlin Steel
Lower Grand R.	Painesville	Diamond Shamrock
Lower Ashtabula R.		Cabot Titania, Detrex Chemical, Olin Mathieson, Reactive Metals
Pennsylvania		
None		
New York		
Cattaraugus Cr.		Moench Tannery, Peter Cooper Glue
Buffalo R.	Buffalo, West Seneca, Depew, Lancaster	Allied Chemical, Donner Hanna Coke, Republic Steel, Mobil Oil

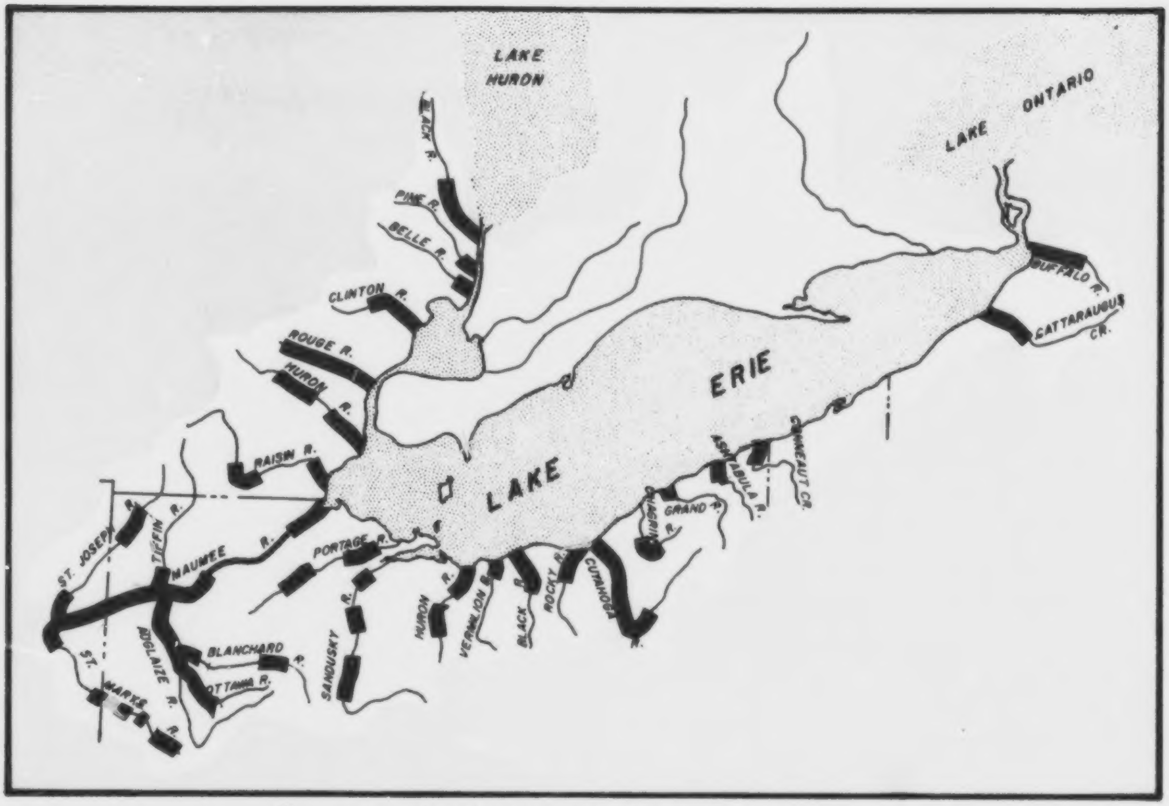

LAKE HURON
BLACK R.
PINE R.
BELLE R.
CLINTON R.
ROUGE R.
HURON R.
RAISIN R.
LAKE ONTARIO
BUFFALO R.
CATTARAUGUS CR.
LAKE ERIE
CONNEAUT CR.
ASHTABULA R.
GRAND R.
CHAGRIN R.
CUYAHOGA R.
ROCKY R.
BLACK R.
VERMILION R.
HURON R.
SANDUSKY R.
PORTAGE R.
MAUMEE R.
TIFFIN R.
ST. JOSEPH R.
AUGLAIZE R.
BLANCHARD R.
OTTAWA R.
ST. MARYS R.

Figure 6 – Heavily Polluted Tributaries to Lake Erie

14. *About 9 million people are served by sewers* and sewage treatment in the U.S. portion of the Lake Erie basin, discharging wastes amounting to 1.5 billion gallons per day. Fifty-seven percent of these are served by only primary treatment while about 2 million people live in areas which are unsewered. After treatment the waste from the sewered population is reduced to an amount equivalent to the oxygen demand of raw sewage from a population of 4.7 million, resulting in a treatment efficiency of 50% for the five Lake Erie basin states.

15. *The ten largest sources of United States municipal wastes* (Figure 7) based upon strength of waste discharged and in decreasing order are as follows:

Detroit, Michigan
Cleveland, Ohio
Toledo, Ohio
Wayne County, Michigan
Akron, Ohio
Euclid, Ohio
Lorain, Ohio
Sandusky, Ohio
Erie, Pennsylvania
Ft. Wayne, Indiana

Few of the basin's municipal plants presently provide adequate treatment.

16. *Large quantities of municipal wastes without any treatment* enter the streams in the Lake Erie basin via combined sanitary and storm water sewers. The amount is estimated at 40 billion gallons yearly. The yearly average strength of the wastes discharged from these sewer systems is estimated to be equivalent to the oxygen demand of raw sewage from a population of 615,000. This raw

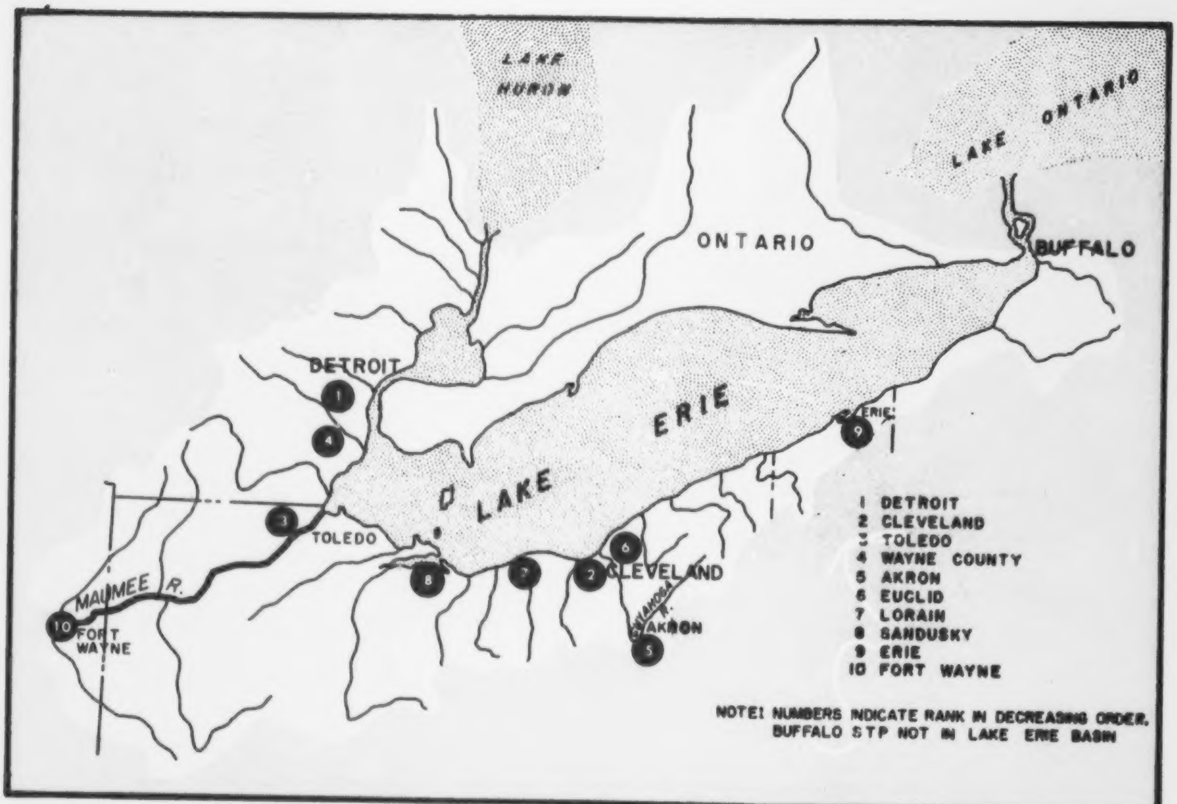
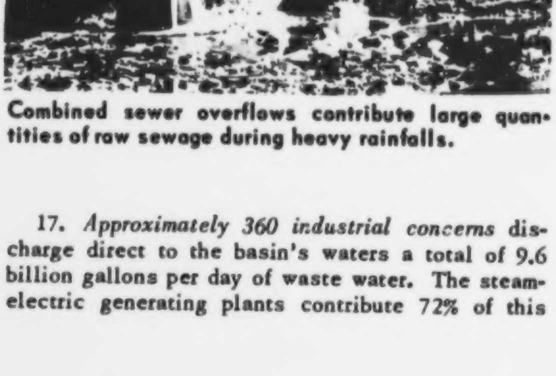

LAKE HURON
LAKE ONTARIO
ONTARIO
BUFFALO
DETROIT
LAKE ERIE
ERIE
TOLEDO
MAUMEE R.
FORT WAYNE
CLEVELAND
CUYAHOGA R.
AKRON
1 DETROIT
2 CLEVELAND
3 TOLEDO
4 WAYNE COUNTY
5 AKRON
6 EUCLID
7 LORAIN
8 SANDUSKY
9 ERIE
10 FORT WAYNE
NOTE: NUMBERS INDICATE RANK IN DECREASING ORDER.
BUFFALO STP NOT IN LAKE ERIE BASIN

Figure 7 – Ten Largest Sources of Municipal Wastes in the U.S. Portion of the Lake Erie Basin

sewage enters the streams in slugs and is a principal cause of contaminated bathing beaches around the Lake Erie shoreline. Ultimate solutions to this vexing problem are not fully known in each metropolitan area, but if sewer separation were undertaken lakewide, the cost of separation would be an estimated $3 billion.



Combined sewer overflows contribute large quantities of raw sewage during heavy rainfalls.

17. *Approximately 360 industrial concerns* discharge direct to the basin's waters a total of 9.6 billion gallons per day of waste water. The steam-electric generating plants contribute 72% of this amount. Known industrial wastes are discharged in an amount equivalent to the oxygen demand of raw sewage from a population of nearly 3 million. Slightly more than half of these industries have inadequate treatment.

18. *The 20 largest producers of industrial waste water* (Figure 8) in decreasing order are as follows: (Excluding steam-electric generating plants)

Industry	Location
Ford	Dearborn and Monroe, Michigan
Republic Steel	Lorain and Cleveland, Ohio and Buffalo, New York
Bethlehem Steel	Lackawanna, N.Y.
Great Lakes Steel	Ecorse and River Rouge, Michigan
Jones & Laughlin Steel	Cleveland, Ohio
Wyandotte Chemical	Wyandotte, Michigan
Pennsalt Chemical	Riverview, Michigan
Gulf Oil	Toledo, Ohio
McLouth Steel	Trenton, Michigan
Allied Chemical	Detroit, Michigan, and Buffalo, N.Y.
Interlake Steel	Toledo, Ohio
Scott Paper	Detroit, Michigan
Standard Oil	Toledo and Lima, Ohio

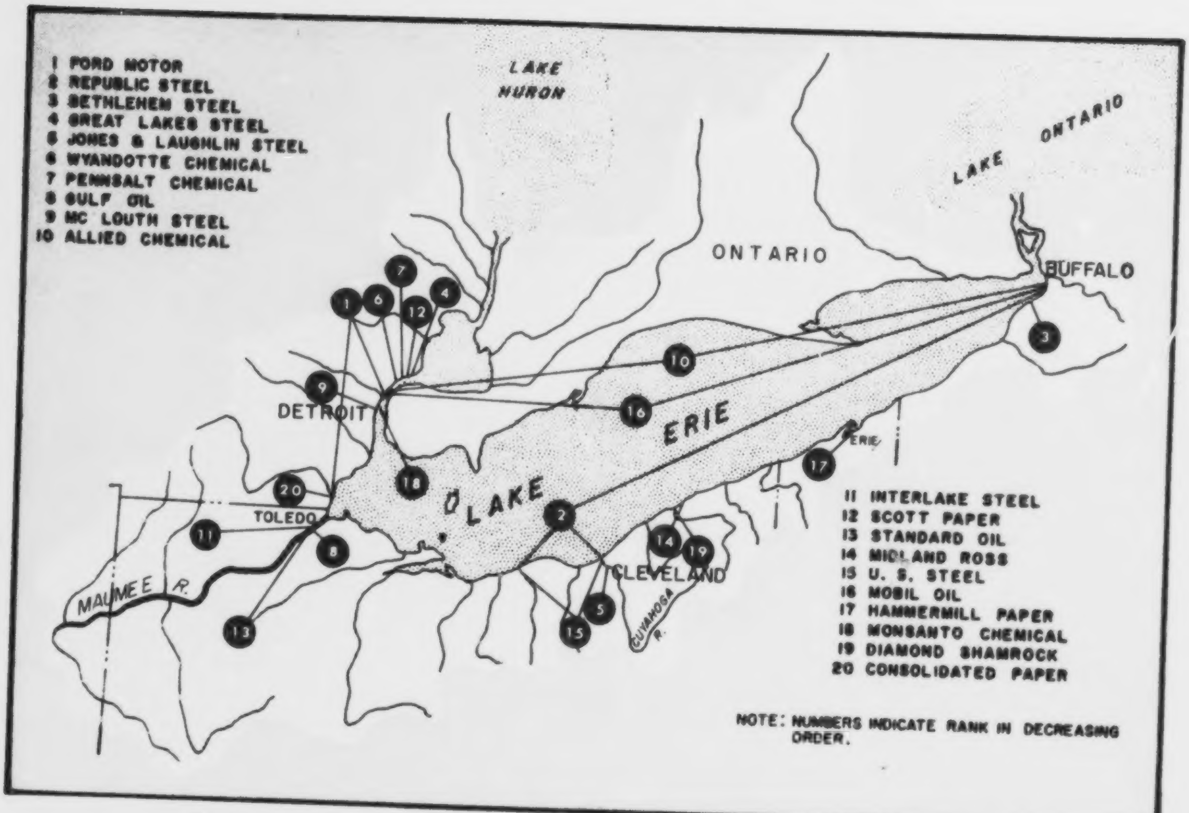
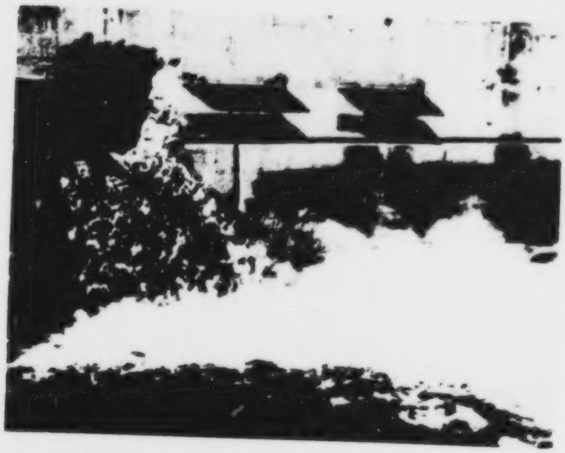

1 FORD MOTOR
2 REPUBLIC STEEL
3 BETHLEHEM STEEL
4 GREAT LAKES STEEL
5 JONES & LAUGHLIN STEEL
6 WYANDOTTE CHEMICAL
7 PENNSALT CHEMICAL
8 GULF OIL
9 MC LOUTH STEEL
10 ALLIED CHEMICAL
LAKE HURON
LAKE ONTARIO
ONTARIO
BUFFALO
DETROIT
TOLEDO
LAKE ERIE
ERIE
CLEVELAND
MAUMEE R.
CUYAHOGA R.
11 INTERLAKE STEEL
12 SCOTT PAPER
13 STANDARD OIL
14 MIDLAND ROSS
15 U. S. STEEL
16 MOBIL OIL
17 HAMMERMILL PAPER
18 MONSANTO CHEMICAL
19 DIAMOND SHAMROCK
20 CONSOLIDATED PAPER
NOTE: NUMBERS INDICATE RANK IN DECREASING ORDER.

Figure 8 – Twenty Major U.S. Industrial Water Users in Lake Erie Basin

Midland Ross	Painesville, Ohio
U.S. Steel	Cleveland and Lorain, Ohio
Mobil Oil	Trenton, Michigan, and Buffalo, New York
Hammermill Paper	Erie, Pennsylvania
Monsanto Chemical	Trenton, Michigan
Diamond Shamrock	Painesville, Ohio
Consolidated Paper	Monroe, Michigan



Almost ten billion gallons of process and cooling waters containing various pollutants are discharged daily by the area's industries.

Oil drilling operations within the basin contaminate waters with both oil and brine.

19. *Oil and gas drilling and exploitation* is expected in the U.S. waters of Lake Erie. It is now being done in Canadian waters. A potential for oil and brine contamination is apparent.

20. *Two enforcement conferences* have been called in the Lake Erie basin, one in 1962 covering just the Michigan waters and then one in 1965 covering the entire lake. Through this procedure in the Federal Water Pollution Control Law and state programs, remedial schedules have been set

for 146 industrial polluters and 118 municipal polluters in the basin with construction of all facilities to be completed by 1972. The remedial schedules developed by the Lake Erie Enforcement Conference are for secondary treatment with an unspecified level of phosphorus removal for municipal wastes. Additional remedial schedules are needed to achieve the necessary phosphorus control.

Rep. Vanik, Stanley Spisiak, Secretary Udall, and former Cleveland Mayor Locher inspect the Cuyahoga River at the time of the second Lake Erie Enforcement Conference.

21. *Successful and total clean-up of Lake Erie's present pollution and effective management of its future water quality will require U.S.–Canadian agreements and cooperation.* Indications that such will be forthcoming are available in Canadian and United States assent to and participation in an investigation of pollution in Lake Erie now underway by the International Joint Commission (IJC). This investigation, requested jointly by the Governments of Canada and the United States in 1964, will culminate in a report from the IJC which will include recommendations for needed remedial measures in both countries.

Acceptance and adoption of the report, which is scheduled for completion in 1969 by the two nations, thus would launch a joint coordinated and unprecedented U.S. and Canadian program to manage Lake Erie's water quality.

22. *The cost of sewerage and treatment* for the next five years sufficient to meet the requirements for municipal and industrial wastes specified in this report is estimated at $1.1 billion for municipalities and $285 million for industry. Of the municipal costs, $400 million is for treatment and $700 million is for sewer construction.

23. *Under the provisions of the Water Quality Act of 1965, water quality standards have been set by the five states bordering Lake Erie and these have been approved with a few qualifications by the Secretary of the Interior.* (The standards call for construction of certain remedial works by 1972.) If the needs specified in the standards submissions are fully and rapidly implemented by the five states, water quality in the interstate tributaries and nearshore lake waters should greatly improve to the extent that the intended uses of these waters will be met. The improvement will be rapid once the facilities are installed and effectively operated. If similar requirements are adopted for intrastate waters, then a commensurate degree of improvement will be achieved for these streams.

24. The remedial program set forth in this report is an ambitious one designed to recover a rapidly diminishing and priceless natural resource. It calls for concerted action from the citizens of the Lake Erie basin and from all levels of government.

The program provides for the elimination of health hazards and nuisances stemming from bacterial pollution, toxic chemical wastes, oxygen-demanding wastes, and debris. It also calls for prevention of emerging problems such as those which could be associated with oil and gas drilling.

Perhaps most important, the remedial program calls for arresting the accelerated eutrophication which is gradually destroying Lake Erie. Accordingly the report recommends the drastic reduction of nutrient inputs. The input levels are based upon the best available information relating inputs, algal production, and the ability of the lake to purge itself of nutrients. The goal is to reduce algal production throughout the western basin of the lake and along all shores to approximately the productive levels now existing in midlake, central, and eastern basin waters. Thus nuisance growths will be greatly reduced in frequency and extent, and probably within two or three years after inputs are under control. It is quite likely, however, that nuisance algal growths will continue to occur occasionally with blooms of proportions something less than at present for some years to come – perhaps ten or more. Hypolimnetic dissolved oxygen depletion, directly related to algal productivity, will continue for at least the same length of time. This is because of the existing very large nutrient storage in bottom sediments. These nutrients are released under naturally occurring conditions, largely uncontrollable at present.

It is uncertain that Lake Erie can feasibly be returned to its pre-existing state of aging, that condition which existed prior to man's appearance, or even to the condition which existed at the turn of the century. It can be reliably predicted that the lake will return to some intermediate state of aging, but the exact state cannot be predicted. Probably more important is that the rate of aging, now accelerating rapidly, can be brought back to near the natural rate. Most important is that these changes will result in a major improvement in water quality and the sustaining of that quality.

RECOMMENDATIONS

The five Lake Erie basin states have agreed to the recommendations arising from the Detroit and Lake Erie Enforcement conferences and have instituted programs designed to achieve the aims of the conferees. In accordance with the Water Quality Act of 1965, the five states also established interstate water quality standards and submitted plans to implement these standards for the Lake Erie basin to the Secretary of the Interior for Federal approval and promulgation. Each of the States' standards have been approved, subject to a few conditions, and adopted by the Secretary of the Interior.

The Federal-State water quality standards implementation plans are of primary significance since they describe in general what must be done to meet the water quality criteria.

Some of the elements incorporated in these plans, and to which the states as a consequence of the standards-setting process are committed, include:

1. The identification of significant sources of municipal and industrial waste water and an estimate of the general level of treatment now practiced by the principal treatment facilities.

2. A time schedule for completion of remedial facilities which will provide for the abatement of substantial existing conventional municipal and industrial pollution by mid-1972.

3. The establishment of secondary treatment as a minimum treatment level for all significant municipal wastes and equivalent treatment as a minimum for industrial wastes.

4. Recognition of the need before 1972 for treatment greater than secondary at specific installations. Also provided is an expression of intent on the part of the state agencies to require nutrient removal to the greatest extent possible consistent with available technology.

5. The establishment of more satisfactory bacteriological quality for body contact sports –– so that this water use within the basin can expand consistent with long-range goals. In order to protect bathing water quality, the states also agreed in a general way to initiate programs to control pollution caused by overflows from combined sewers.

6. General recognition and incorporation of the recommendations of the Detroit River and Lake Erie enforcement conferences along with the results of the evaluation by the latter's technical committee on nutrients and their effects.

Each of the states is being requested to adopt an anti-degradation clause in its water quality standards similar to the following: "waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at their existing high quality. These and other waters of a state will not be lowered in quality unless and until it has been affirmatively demonstrated by the state water pollution control agency and the Department of the Interior that such change is justifiable as a result of necessary economic or social development and will not interfere with or become injurious to any assigned uses made of, or presently possible in, such waters. This will require that any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters will be required, as part of the initial project design, to provide the highest and best degree of waste treatment available under existing technology; and since these are also Federal standards, these waste treatment requirements will be developed cooperatively."

As of May 1, 1968, only Michigan has adopted such a clause.

In some cases the water quality standards include requirements in addition to the above or include other expressions of intent. As an example, Ohio standards recognize and support the elements of the Northwest Ohio Water Development Plan developed by the Ohio Water Commission. This Ohio plan emphasizes among other requirements the need within the next decade for establishing sewer systems and advanced waste treatment systems in most of the municipalities in Northwest Ohio.

The water quality standards were not intended to be the final answer in all phases of water pollution control for all time to come. By its own nature the standards setting process precluded certain actions and discussions necessary for the total task of saving Lake Erie. This report presents a total unified water pollution control program for the lake which brings together the requirements of each of the states' individual water quality standards and outlines additional needs that go beyond those not specified or intended in the standards. It is a plan for control of pollution based upon the best knowledge existing today. It is expected that as conditions and needs change that actions to meet these new needs will change accordingly. Furthermore it must be kept in mind that detailed engineering analyses of individual municipal and industrial waste treatment needs by state and local units of government may indicate alternative but equally good means of reducing waste loads.

Some of the elements that were not incorporated in water quality standards that are incorporated in this document on Lake Erie include:

1. The need for defining long-range pollution control programs necessary to maintain high quality water in Lake Erie after standards have been implemented.

2. International cooperation from the Canadian Province of Ontario and its role in the remedial pollution control program for Lake Erie.

3. Recognition of certain problems such as oil and gas well drilling in the lake.

4. Numerous areas where large scale research and development is needed to aid in the restoration of the lake.

5. Programs to bring about the centralization of sewerage systems to control water pollution on a metropolitan or area-wide basis.

6. Requirements for control of intrastate in addition to interstate pollution.

In the standards setting process, a number of agreements and requirements were specified in general terms. This document spells out in detail these requirements especially in regard to the following:

1. Those communities needing advanced waste treatment and certain communities needing secondary treatment that were not named specifically in water quality standards reports.

2. The specific level of treatment necessary to limit the discharge of nutrients and oxygen-demanding substances in municipal and certain industrial wastes in order to meet the established water quality criteria for Lake Erie and its tributaries.

3. Individual requirements for control of pollution from combined sewers.

4. Treatment requirements and control methods needed for certain Federal programs and installations on Lake Erie.

The recommendations which follow are designed to achieve the established water quality standards for the Lake Erie basin.

In regard to the interstate waters of the basin, recommendations 1, 5, 6, 8, 9, 10, 11, and 17 are covered in some way or pertain to the remedial measures specified in the water quality standards and implementation plans.

POLLUTION CONTROL NEEDS

1. *Michigan, Indiana, Ohio, Pennsylvania, and New York should pursue diligently and expeditiously (a) the requirements of the enforcement conference, (b) their plans of implementation designed to achieve the water quality standards for Lake Erie, and (c) the additional recommendations specified in this report.*

2. *Michigan, Ohio and Pennsylvania should adopt water quality standards for intrastate streams* and these should be consistent with those adopted for interstate waters. New York and Indiana have already adopted intrastate standards; others are presently holding or have completed hearings pursuant to the adoption of intrastate standards.

3. *Each of the five Lake Erie basin states should have the necessary financial support* to construct the waste treatment facilities to meet the established water quality standards for the Lake Erie basin. The five states either have or are obtaining legislation and bonding authority to secure the financial support, but in some cases the amount of money is insufficient.

4. *Each of the five Lake Erie basin states should obtain the necessary public and legislative support to strengthen its water pollution control programs* in the areas of operator training, and optimal maintenance and operation of waste treatment plants. Surveillance, enforcement, and water quality management activities also should be increased.

5. *Each of the five Lake Erie basin states should establish and maintain waste discharge limits* of oxygen-consuming substances as measured by the 5-day biochemical oxygen demand (BOD) test for each major drainage basin in the Lake Erie watershed sufficient to meet stream standards. This discharge limit should be no greater than the summation of the individual municipal and industrial waste effluent loads that will be expected when the recommendations for treatment specified in this report are met.

6. Each of the states should require treatment of wastes to the extent that the basinwide total phosphorus discharged from municipal and industrial sources will not exceed 9,000 lbs/day. This will require an average reduction in the present rate of input from such sources of about 90 percent. By the year 1990, nearly complete removal of phosphorus from municipal and industrial wastes, together with substantial reduction in the phosphorus contribution from runoff, will be required to accommodate projected population increase.

Algae (cladophora) along the Ohio shoreline near Sandusky.

No cities presently treat to this level in the Lake Erie watershed although it is recognized that the states are embarking on a program to require treatment.

7. *Each of the five Lake Erie states should encourage the adoption of area-wide sanitary authorities* to control water pollution on a metropolitan basis. Such master planning and expanded area-wide control is currently needed in the metropolitan areas of Detroit, Michigan; Toledo, Akron, and Cleveland, Ohio; and Buffalo, New York. It is recognized that most major cities already provide some sewer service to other communities and that many areas including the Detroit, Cleveland, and Buffalo metropolitan areas are embarking on programs to provide much greater area-wide control. Those communities in Ohio within the metropolitan areas of Cleveland and Akron that are listed in Recommendation No. 8 as needing advanced waste treatment should, as the best approach, join the metropolitan plan recommended for development by Cleveland and Akron. *By the year 1990 most cities should be served by metropolitan area waste disposal systems.* Exceptions will be cities located in remote reaches of the watershed where population is not expected to increase. *In addition, the five Lake Erie basin states should begin now to develop institutional arrangements* that bring appropriate communities, industries, and metropolitan areas together for the purpose of planning and financing pollution control measures within the framework of entire drainage basins.

Ohio Water Pollution Control Board's Intrastate Standards hearing for North-Central Ohio area. (ODH)

8. In order to protect the oxygen resources of inland streams in portions of the Lake Erie watershed, *the following municipalities need treatment at a degree greater than secondary* or connection to an area-wide collection and treatment system:

Indiana

Auburn
Decatur
Fort Wayne
Garrett

Ohio

Akron
Amherst
Archbold
Attica
Bellevue
Berea
Bloomdale
Bloomville
Bowling Green
Brook Park
Bryan
Carey
Cleveland Southerly
Clyde
Columbus Grove
Crestline
Cuyahoga Falls
Delphos
Delta
Elyria
Findlay
Fostoria
Fremont
Gibsonburg
Grafton
Greenwich
Kent
LaGrange
Lima
McComb
Medina
Middleburg Hts.
New London
New Washington
North Baltimore
North Royalton
Norwalk
Oberlin
Olmsted Falls
Ravenna
St. Marys
Spencer
Stow
Strongsville
Tiffin
Toledo
Upper Sandusky
Van Wert
Wapakoneta
Wauseon

New York

East Aurora
Eden Twp.
Hamburg Village
Gowanda (if industrial wastes are included)
Holland Twp.
North Collins

By 1990, in order to protect the oxygen resources of the basin, treatment of municipal wastes at a degree greater than secondary will be necessary throughout the basin.

9. *Immediate measures must be instituted by the states to provide for bathing conditions which meet health standards.* Since the major cause of the public health problem at bathing beaches is the discharge of fecal matter from combined storm and sanitary sewers and inadequately treated sewage, the immediate measures should take the form of disinfection at the outlets in the vicinity of bathing areas and diversion of troublesome outlets to remote areas away from beaches. Existing public beaches should be opened for bathing as soon as adequate emergency control measures are taken. Local water pollution control agencies should establish surveillance of the sewer outlets that have been designated as affecting bathing beach areas to see that all discharges are adequately disinfected. In addition the beaches themselves should be continuously monitored to assure maximum protection to public health.

10. *The five Lake Erie basin states should begin or accelerate programs to devise methods to deal with the problems of storm and combined sewer overflows. By 1980 all cities should have eliminated pollution (including nutrients) caused by urban runoff and combined sewer overflows.* All outlets to surface waters should then be disinfected and directed away from recreational areas.

11. Many industries in the Lake Erie basin need treatment facilities to abate pollution and to meet established water quality standards. It is recognized that many of the industries named below may already have substantial abatement programs underway or may have completed the necessary treatment facilities.

a. *The iron and steel industry should install, operate, and maintain or otherwise increase waste reduction facilities* to effectively reduce taste and odor producing substances, suspended solids, acids, oils, cyanides, and substances that cause discoloration in receiving streams, to levels that will comply with the water quality standards for Lake Erie and its tributaries. This includes but is not limited to the following industries:

Michigan

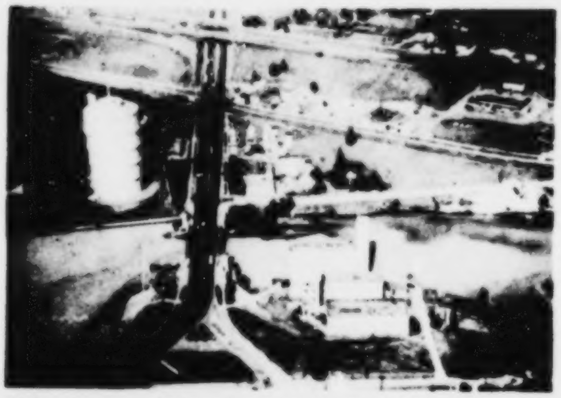
Ford Motor Co. Rouge Plant, Dearborn
Great Lakes Steel Corp., Detroit, River Rouge, and Ecorse
McLouth Steel Corp., Trenton and Gibraltar

Ohio

Interlake Steel Corp., Toledo
U.S. Steel Corp., Lorain and Cleveland
Jones & Laughlin Steel Corp., Cleveland
Republic Steel, Elyria and Cleveland

New York

Republic Steel, Buffalo
Bethlehem Steel Corp., Lackawanna
Donner Hanna Coke, Buffalo



Oils, iron, solids, phenols, oxygen demanding materials, etc. are discharged by the iron and steel producing industries.

b. *The petroleum industry should install, operate, and maintain or otherwise increase waste reduction facilities* to reduce phenolic discharges to the extent that taste and odors are eliminated, and to reduce oil wastes to the extent that no oil films are visible in the receiving stream. This includes but is not limited to the following industries:

Michigan

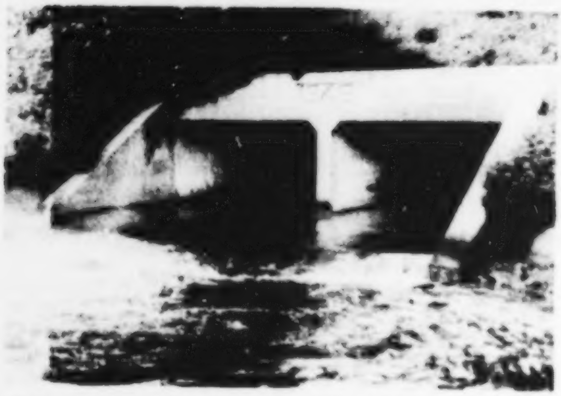
Mobil Oil, Detroit

Ohio

Sun Oil, Toledo
Pure Oil, Toledo
Standard Oil, Toledo and Lima
Ashland Oil, Findlay

New York

Mobil Oil, Buffalo



This oil refinery outfall daily discharges 11,000 pounds of oil.

c. *The heavy chemical and rubber industry should install, operate and maintain or otherwise increase waste reduction facilities* to control their discharges of suspended and dissolved solids to comply with established water quality standards. This includes but is not limited to the following industries:

Michigan

Allied Chemical Corp., Detroit
Pennsalt Chemical Corp., Riverview and Wyandotte
Wyandotte Chemical Corp., Wyandotte

Ohio

Firestone Tire & Rubber Co., Akron
Diamond Shamrock Corp., Painesville
Midland Ross Corp., Painesville
Reactive Metals, Inc., Ashtabula
Olin Mathieson Corp., Ashtabula
Cabot Titanium Corp., Ashtabula
B.F. Goodrich Co., Akron
Goodyear Tire & Rubber Co., Akron

New York

Allied Chemical Corp., Buffalo

d. *The paper, food-producing, and other allied industries should install, operate, maintain, or otherwise increase waste reduction facilities* to control the discharge of suspended solids, oxygen-demanding substances, and color so that the flow from such plants meets state requirements including those for the total allocated oxygen demand load to the lake. This includes but is not limited to the following industries:

Michigan

Scott Paper Co., Detroit
Darling & Co., Detroit
Time Container Corp., Monroe
Union Bag-Camp, Monroe
Michigan Milk Producers Assn., Peck and Imlay City
Port Huron Paper Co., Port Huron
Vlasic Food Products Co., Imlay City
Peninsula Paper Co., Ypsilanti
Simplex Paper Corp., Palmyra

Indiana

Parrot Packing Co., Fort Wayne

Ohio

Weston Paper Co., St. Marys
Beatrice Foods Co., St. Marys
Foster Duck Farm, Montgomery Twp.
Hirzel Canning Co., Pemberville
Cuyahoga Meat Co., Cleveland
Chase Bag Co., Chagrin Falls

Pennsylvania

Albro Packing Co., Springboro
Gunnison Bros., Girard Township
Hammermill Paper Co., Erie

New York

Welch Grape Juice, Westfield and Brocton
Seneca Westfield Maid, Westfield
Growers Coop Grape Juice, Westfield
Pro-Canners Coop, No. Collins
Gro-Packers Coop, No. Collins
Peter Cooper Co., Gowanda
Moench Tannery, Gowanda

Waste reduction facilities for solids and oxygen demanding materials are needed for paper and food processing plants.

12. *State and Federal agricultural agencies should begin or accelerate programs to control sediment loss, oxygen-demanding substances, and fertilizing agents from animal feed lots and farmland runoff.*

13. Discussions are now underway for gas and oil exploration in Lake Erie. Should such drilling proceed, *the oil and gas producing industry should install and operate waste elimination equipment on rigs to be used in the U.S. waters of Lake Erie to the extent that oil or other substances do not pollute the waters of the lake.*

14. The Corps of Engineers should find *suitable methods of disposal of polluted harbor dredging spoils* other than open lake dumping.

15. Each municipality, port authority, or industry containing a harbor should establish procedures to *preven. and control oil spillage* in harbor waters.

16. Interstate and Federal mobilization machinery to handle potential large oil spillages in the lake proper should be strengthened.

17. Recommendations which have been specified by the states in their plans to implement water quality standards which bear repeating are as follows:

a. *Control of vessel pollution.*

b. *Controls prohibiting open dumping* of garbage, trash, and other deleterious refuse along the shores of Lake Erie and its tributaries.

c. *Disinfection of all municipal treatment plant wastes.*

d. *Establishment and implementation of soil erosion control programs.*

18. Research should be undertaken or continued on the following aspects:

a. *Control of nutrient input* to Lake Erie through better treatment methods, reduction of nutrient input in agricultural runoff, and development of a suitable product solution for phosphorus contained in detergents.

b. Effective means to *prevent the formation of oxygen-deficient zones* in mid-Lake Erie.

c. Determination of the *exact role of Lake Erie bottom sediments* in the overall chemistry of Lake Erie.

d. Effective means to *reduce pollution from rural runoff.*

e. Effective means to *restore the Lake Erie fishery.*

f. Determination of the *role of pesticides* in Lake Erie pollution.

g. Determination of the *role of radioactive* substances in Lake Erie pollution.

h. Determination of the *effects of potential increased thermal pollution* in Lake Erie.

i. *Eutrophication* or aging of lakes.

Water for all uses is needed for future generations.

19. The Great Lakes Basin Commission should utilize the findings of this report as a basis for the pollution control portions of their multiple-purpose planning efforts on Lake Erie. This report should also provide a base of data and recommendations for consideration by the International Joint Commission in its "Report on the Pollution of Lake Erie, Lake Ontario, and the International Section of the St. Lawrence River", scheduled for completion in 1969.

20. Municipal and industrial plant inspection, data gathering, and *monitoring activities of the Lake Erie states and the FWPCA should be coordinated* and expanded to maintain intimate knowledge of waste loadings, bypasses, treatment plant efficiencies, and illegal discharges in order that such information may be used in day-to-day water quality management.

CHAPTER 1

THE BASIN AND ITS FEATURES

GENERAL DESCRIPTION

The Great Lakes are similar in their origin and history but Lake Erie stands apart in its physical characteristics. These characteristics make it more susceptible to the manifestations of water pollution, as will be seen in Chapter 3—The Pollution Problem.

The Lake Erie basin (Figure 1-1) is 40,000 square miles of generally low-level, flat, clay-rich land, formed by glacial abrasion and deposition. The topography in the southeastern part of the basin is hilly and more rocky. Streams throughout are characteristically sluggish and winding and carry high silt loads, especially in the western part of the basin. Most streams also carry huge waste loads.

Lake Erie proper, occupying 9,940 square miles, lies for the most part in the east half of the drainage basin. The lake deepens toward the east to a maximum depth of 216 feet, but the average depth for the entire lake is only 60 feet. The bottom is very flat (Figure 1-2) and is comprised mainly of dark sludge-like mud (Figure 1-3). The lake is divided into three subbasins: the *western basin, central basin,* and *eastern basin.* The rocky island chain separates the shallow western basin from the central basin, and a low, wide, submerged sand and gravel ridge separates the deep eastern basin from the central basin. *The physical character of each of these basins has great bearing on their responses to waste inputs.*

WESTERN BASIN

The western basin (1,200 square miles) is shallow, flat, and sludge-covered with interruptions by a few reefs and rocky islands. The shores are nonresistant clays except for rock in the island area.

The water of the western basin is more turbid than in the remainder of the lake because of large silt input, wave stirring, and high algal productivity. It is subject to large, short-period changes in water level. *Natural circulation (Figures 1-4 and 1-5) is controlled by the large Detroit River inflow* and prevailing winds. The Detroit River penetrates far southward into the basin and then drains for the most part through the northern island channels. The Maumee River, generally silt-laden, is the largest tributary originating in the Lake Erie watershed, and flows into the west end of the basin. The dispersion of its discharge and that of the Michigan shore streams is retarded somewhat by the Detroit River flow, resulting in high concentrations of pollutants along the western shore.

The water of the western basin is usually uniform in temperature, top to bottom, but responds more quickly (because of its shallowness) to atmospheric temperature changes than the remainder of the lake. Occasionally in summer *the water stratifies thermally for short periods leading to rapid oxygen depletion near the bottom, drastically affecting bottom organisms.*

CENTRAL BASIN

The central basin of Lake Erie is by far the largest of the three basins, covering approximately 6,300 square miles. Its average water depth is 60 feet with a maximum of about 80 feet. The shores are generally high clay banks with narrow beaches. *The bottom is, for the most part, remarkably flat and comprised of mud with high organic content.* Sand and gravel with shallower water depths, exist near shore and in a broad submerged ridge extending south-southeastward from Point Pelee, Ontario.

Although the central basin receives more than 90 percent of its water supply from the western basin drainage, the water is considerably less turbid and less biologically productive. However, *productivity is high along the south shore.*

Water temperatures in the central basin are uniform top to bottom from fall until late spring. In winter the entire basin is occasionally ice-covered. From June until September it is temperature-stratified with a thermocline 50 to 60 feet below the surface. The thermocline is usually so sharp that 75°F water is essentially floating on 55°F water. *During stratification the relatively thin bottom cold water layer (hypolimnion) may lose all of its dissolved oxygen while the upper warm water (epilimnion) remains at or above saturation.* The loss of dissolved oxygen in the hypolimnion is progressive and the minimum is usually recorded late in the stratification period, in August or September. The hypolimnion begins to thin when the lake starts cooling in August, and disappears in late September

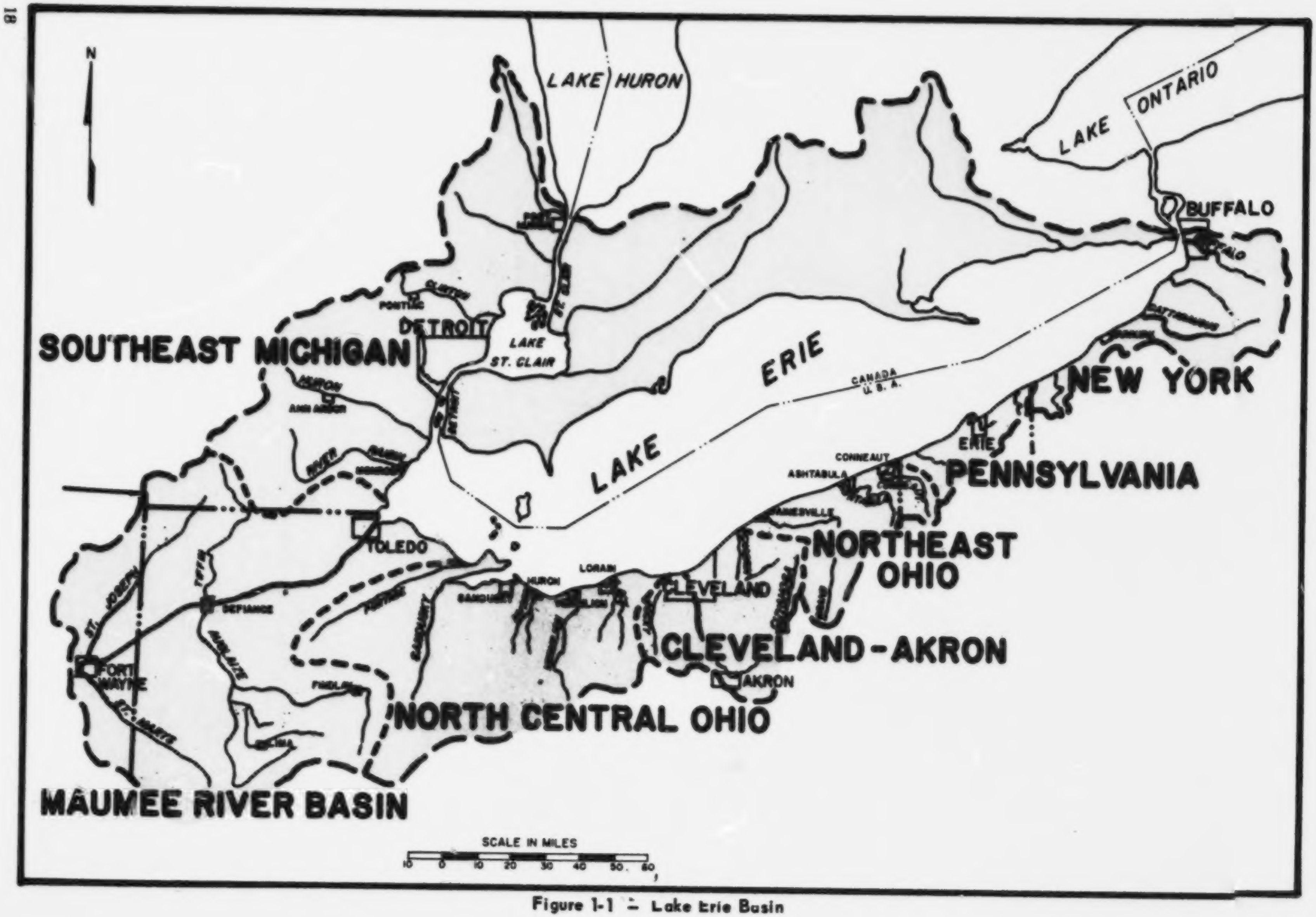

N
LAKE HURON
LAKE ONTARIO
BUFFALO
SOUTHEAST MICHIGAN
PONTIAC
DETROIT
LAKE
ST. CLAIR
ANN ARBOR
LAKE
ERIE
CANADA
U. S. A.
NEW YORK
ERIE
CONNEAUT
ASHTABULA
PENNSYLVANIA
TOLEDO
NORTHEAST
OHIO
HURON
LORAIN
CLEVELAND
SANDUSKY
DEFIANCE
FORT
WAYNE
CLEVELAND - AKRON
AKRON
NORTH CENTRAL OHIO
MAUMEE RIVER BASIN
SCALE IN MILES
10
0
10
20
30
40
50
60

Figure 1-1 – Lake Erie Basin

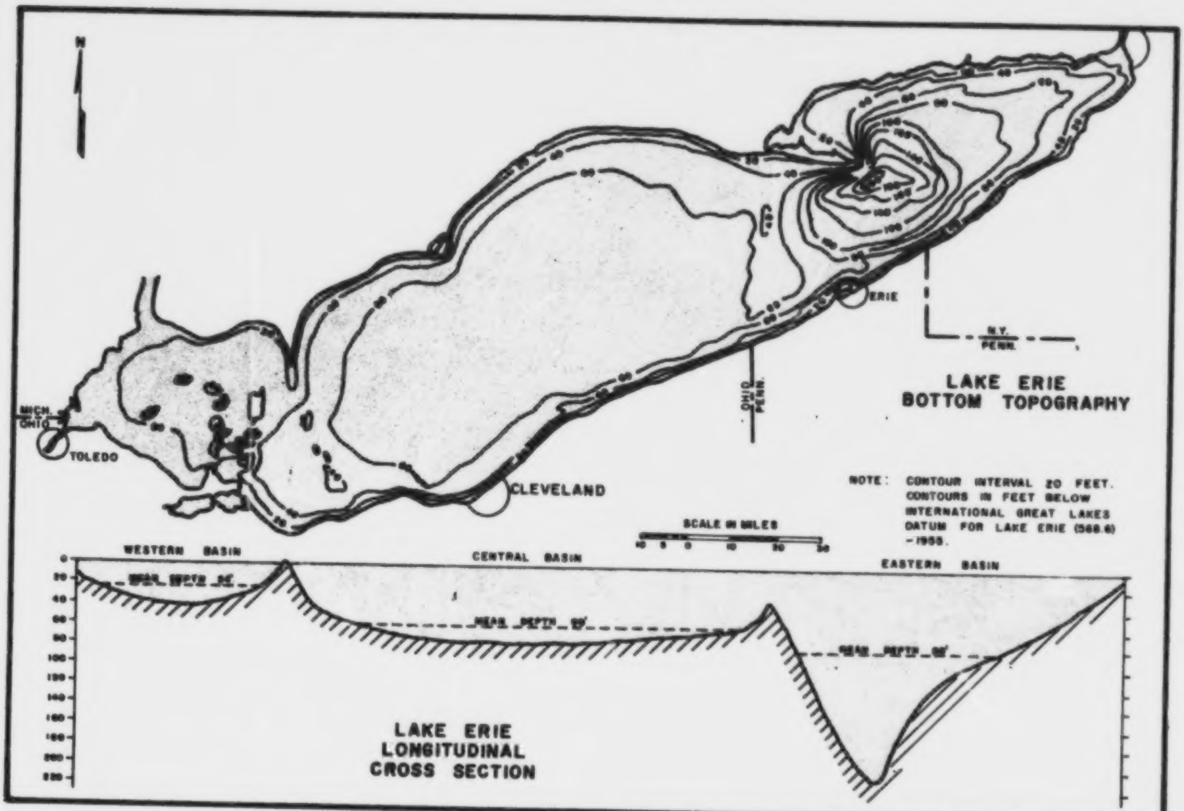

N
LAKE ERIE
BOTTOM TOPOGRAPHY
ERIE
N.Y.
PENN.
OHIO
PENN.
MICH.
OHIO
TOLEDO
CLEVELAND
NOTE: CONTOUR INTERVAL 20 FEET. CONTOURS IN FEET BELOW INTERNATIONAL GREAT LAKES DATUM FOR LAKE ERIE (568.6) - 1955.
SCALE IN MILES
WESTERN BASIN
CENTRAL BASIN
EASTERN BASIN
MEAN DEPTH
LAKE ERIE
LONGITUDINAL
CROSS SECTION

Figure 1-2 – Lake Erie Bottom Topography

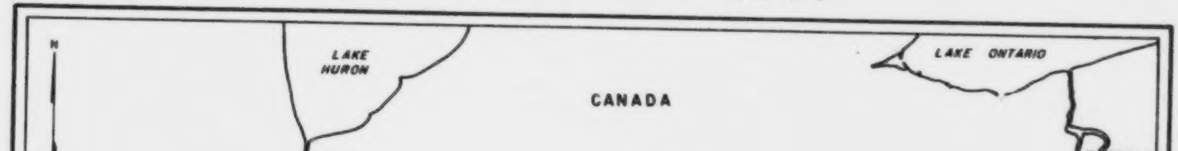

N
LAKE HURON
CANADA
LAKE ONTARIO
BUFFALO
DETROIT
LAKE ST. CLAIR
ERIE
TOLEDO
CLEVELAND
SAND
MUD
CLAY
ROCK
SCALE
10 5 0 10 20 30

Figure 1-3 – Bottom Deposits in Lake Erie

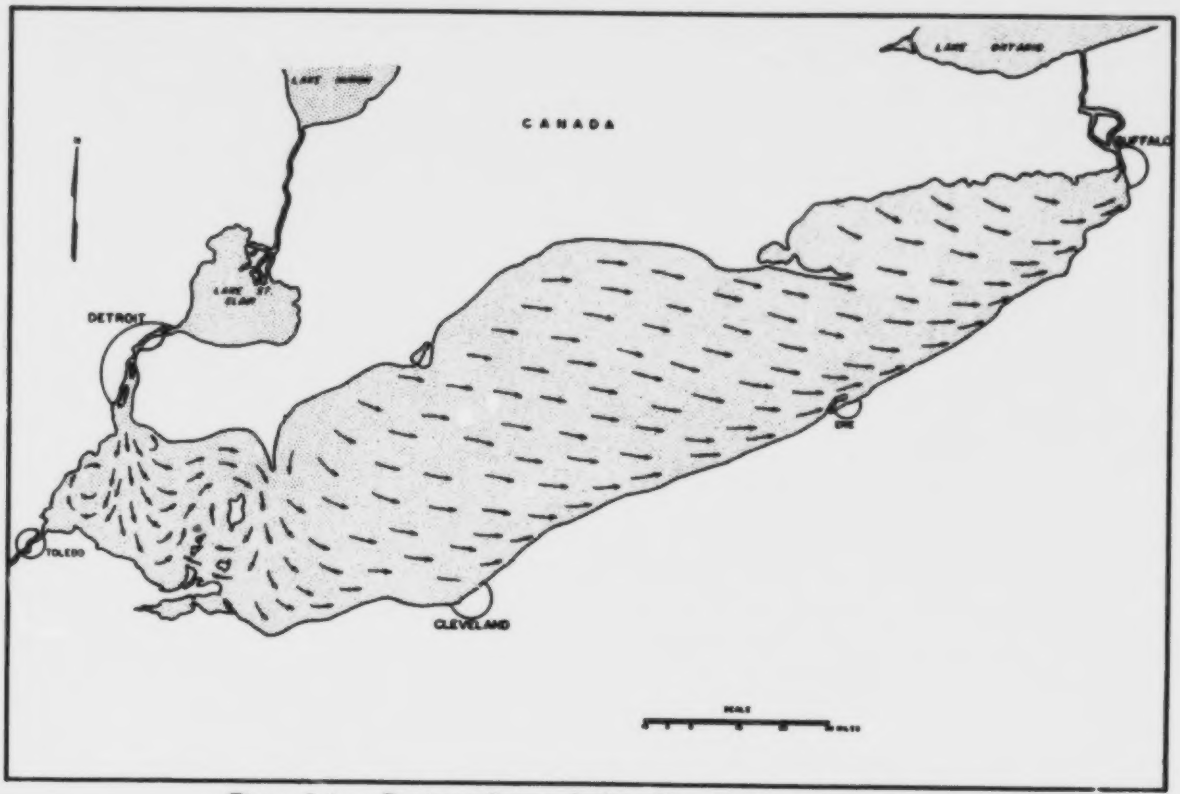

LAKE HURON
CANADA
LAKE ONTARIO
BUFFALO
LAKE ST. CLAIR
DETROIT
ERIE
TOLEDO
CLEVELAND
SCALE

Figure 1-4 – Dominant Summer Surface Flow Pattern in Lake Erie

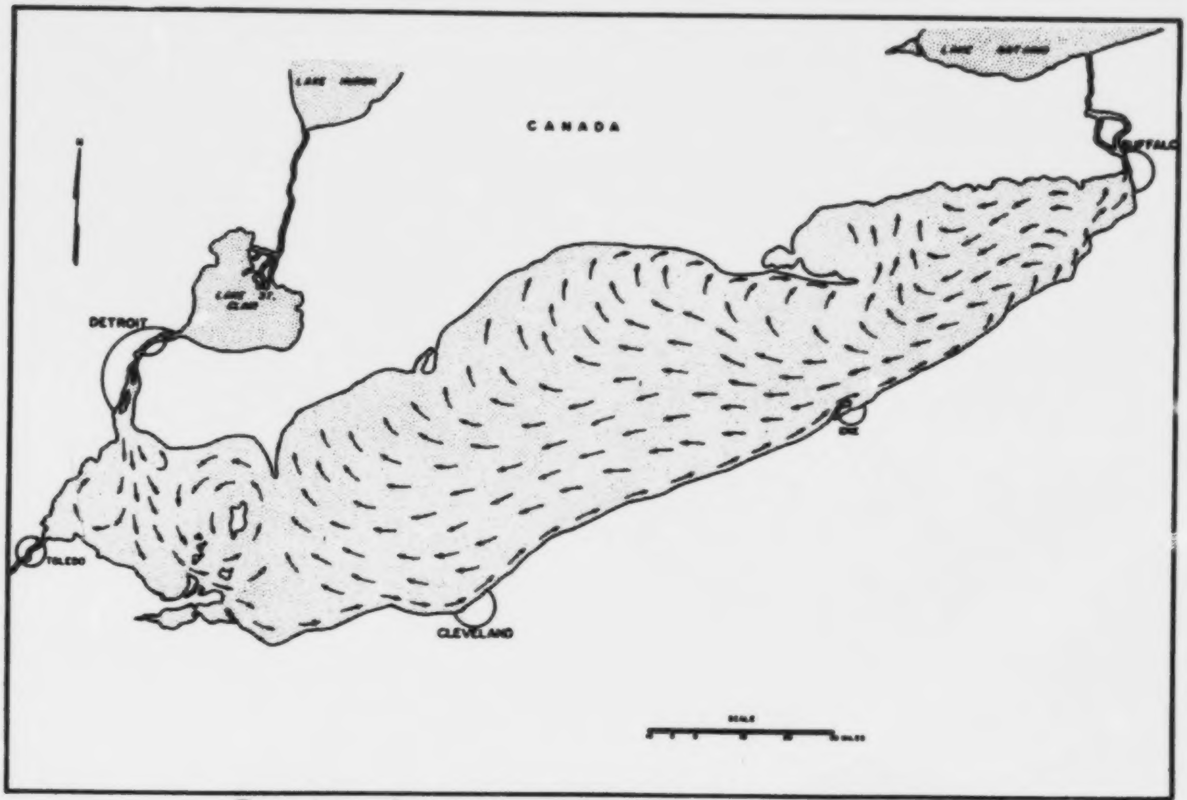

LAKE HURON
CANADA
LAKE ONTARIO
BUFFALO
LAKE ST. CLAIR
DETROIT
ERIE
TOLEDO
CLEVELAND
SCALE

Figure 1-5 – Dominant Summer Bottom Flow Pattern in Lake Erie

or early October. Then an oxygen-deficient zone no longer exists.

Because of the basin's large cross-section, the flow-through current is immeasurably slow and circulation is controlled by the wind. Although reversals are common with wind shifts, the predominant *surface* water movement (Figure 1-4) is eastward angled away from the north shore and toward the south shore. This is caused by prevailing southwest winds. The predominant bottom water flow is southwestward (Figure 1-5), a compensation to the relatively rapid eastward surface flow. Near the south shore the flow is toward the east, top to bottom, tending to retain pollution inputs along the shore. Often, however, pollutants escape this zone to be widely dispersed. Summer and winter circulations are similar in the central basin, except that in summer the thermocline is, in effect, an "elastic" bottom which shifts in depth and location with stress caused by the wind. *The hypolimnion although it has no net movement, slides around in the basin and this results in unusually hign velocities (up to 2 ft/sec) at the bottom*, much higher than at other times of the year, and capable of resuspending bottom sediments. This phenomenon tends to hasten oxygen depletion in the hypolimnion.

Materials suspended in central basin water appear to accumulate on the bottom on the north side of the lake near the west end of the basin. This is a result of the westward bottom flow which both upwells and becomes a large clockwise eddy in that area. *Materials escaping the south shore eastward flow can actually cross the lake when caught in this bottom flow.*

Water levels generally do not fluctuate greatly with the wind in the central basin. Wave activity in the central basin during storms is often violent, a danger to boating, and causes rapid shore erosion. Wave activity also causes faster longshore currents and more rapid and widespread dispersion of contaminants.

EASTERN BASIN

The eastern basin of Lake Erie contains the deepest water (maximum 216 feet) and the cleanest water of the three basins. The area of the basin, 2,400 square miles, is intermediate between that of the western and the central basins. In general, the water is clear and is the least biologically productive, although productivity is substantial near the south shore. This basin is generally considered less *eutrophic* than the remainder of the lake.

The eastern basin receives more than 90 percent of its water supply from the central basin. The temperature structure of eastern basin water is similar to that of the deeper Great Lakes. It rarely freezes over although it maybe covered by drift ice. In summer it stratifies but the hypolimnion remains at a low temperature, about 40°F. The thermocline is thick, 25 feet or more, forming in early summer, and deepening rapidly to 40 to 50 feet below the surface. The depth to the thermocline increases as summer progresses and reaches 120 feet or more by the time it breaks up in November.

Dissolved oxygen content declines in the eastern basin hypolimnion in summer, but rarely to less than 50 percent of saturation mainly because of its large volume, slow movement, and low temperature. The eastern basin hypolimnion is effectively separated from the central basin hypolimnion by the sand and gravel bar crossing the lake between Long Point, Ontario and Erie, Pennsylvania.

Currents in the eastern basin (Figures 1-4 and 1-5) are similar in gross pattern to those of the central basin except that those in bottom waters are always very slow. Near the thermocline they are confused by thermoclinal waves causing vertical and horizontal dispersion. The nearshore flow is similar to that of the central basin, but confined to a narrower zone because of relatively deep water. Here again shore inputs are largely confined to this zone. Materials escaping this zone may disperse widely.

HYDROLOGY

Precipitation averages about 34 inches annually over the Erie basin, but varies somewhat from place to place (Figure 1-6). It is fairly evenly distributed throughout the year. About one-third of the precipitation is lost in runoff.

The water balance in Lake Erie is shown in Table 1-1. The important tributary inputs to Lake Erie are shown in Figure 1-7. Only five tributaries to Lake Erie exceed an average flow of 1,000 cubic feet per second (cfs). These are, in order of decreasing contribution, the Detroit-St. Clair River system, the Maumee River, the Grand River (Ontario), the Thames River, and the Sandusky River. Pertinent hydrologic factors on tributaries are given in Table 1-2. All tributaries, except the St. Clair River, are characterized by very low flows in summer (Fig. 1-8).

Ground water in the basin varies considerably in quantity and quality. These are summarized in Figures 1-9 and 1-10. In general, the basin is a rather poor producer of ground water.

Basin water resources are for the most part not managed for flow regulation and flood control. Some reservoirs mainly for water supply storage have been built or are being built on the Maumee, Sandusky, Cuyahoga, Rocky River, Grand River (Ohio), and on Canadaway, Silver, Chatauqua, Clear Lake, and Slippery Rock Creeks. Flow regulation for waste assimilation is being considered on the Buffalo, Cuyahoga, Sandusky, Maumee, Huron (Mich.), and Raisin Rivers.

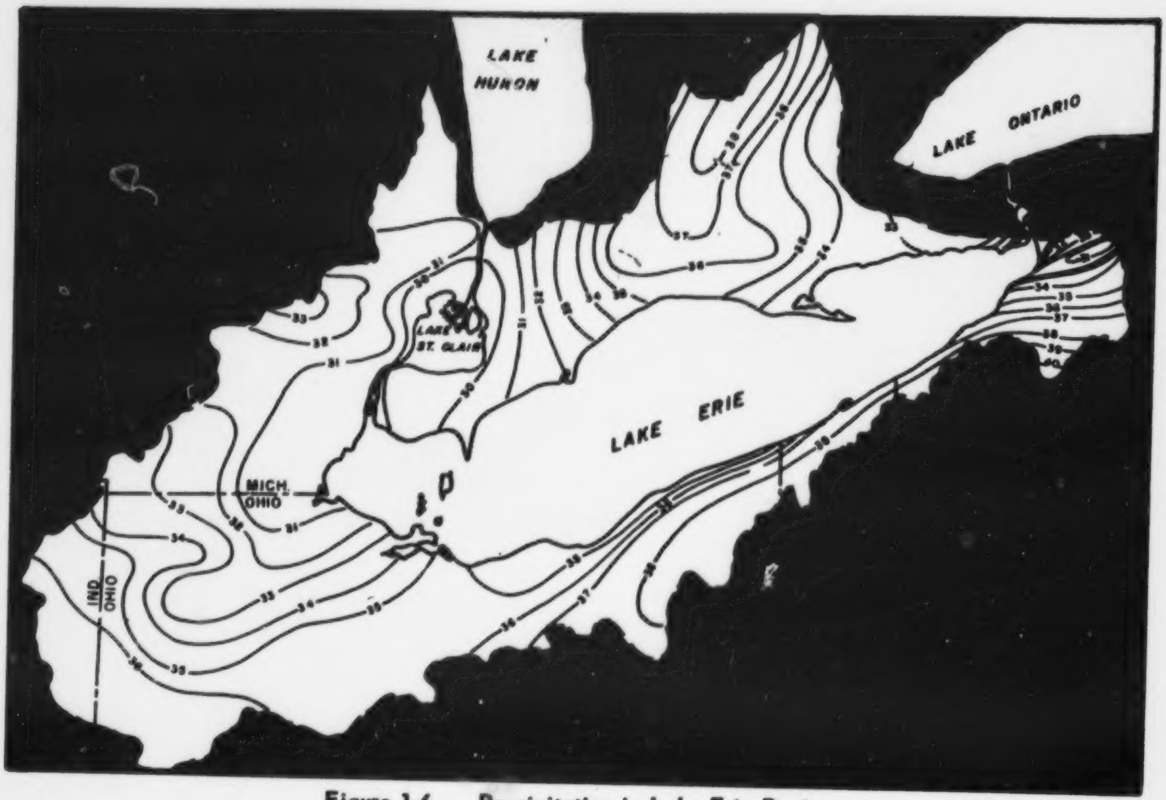


Figure 1-6 – Precipitation in Lake Erie Basin

TABLE 1-1

ESTIMATED WATER BALANCE IN LAKE ERIE
(cfs)

	P	+	R	+	I	–	O	–	D	–	E	=	ΔS
January	18,000		32,000		168,700		193,400		--		27,400		–2,100
February	18,200		44,300		159,600		187,300		--		39,400		–4,600
March	22,500		56,400		172,500		192,100		--		38,600		20,700
April	27,200		54,000		185,600		201,400		5,250		–4,050*		64,200
May	26,900		32,000		191,900		213,300		10,500		–4,000*		31,000
June	24,000		21,300		196,400		216,200		10,500		2,200		12,800
July	24,000		8,100		199,600		212,800		10,500		10,500		–2,100
August	24,000		8,100		199,800		209,900		10,500		30,100		–18,600
September	21,600		8,300		198,400		204,800		10,500		45,100		–32,100
October	18,800		8,100		196,500		200,800		10,500		45,200		–33,100
November	21,600		12,700		193,900		200,800		10,500		44,700		–27,800
December	18,800		20,600		186,500		200,100		5,250		28,850		8,300
Annual Average	22,000		25,000		187,000		203,000		7,000		25,000		—

P = precipitation on lake's surface
R = runoff
I = inflow from upper lakes
O = outflow via Niagara River
D = diversion via Welland Canal
E = evaporation from lake's surface
ΔS = change in lake's storage
* = condensation

GPO 808-695-2

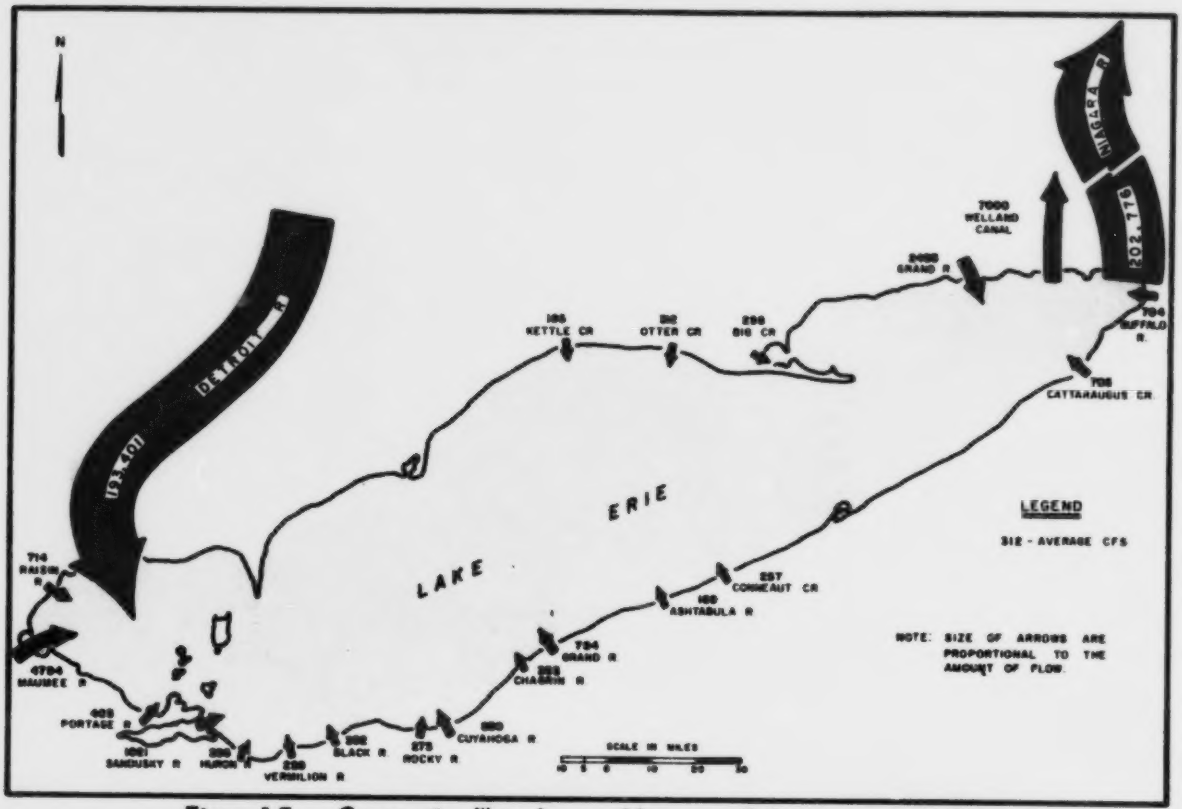

N
DETROIT R
193,401
714 RAISIN R
4794 MAUMEE R
403 PORTAGE R
1021 SANDUSKY R
296 HURON R
228 VERMILION R
302 BLACK R
273 ROCKY R
850 CUYAHOGA R
333 CHAGRIN R
784 GRAND R
169 ASHTABULA R
257 CONNEAUT CR
705 CATTARAUGUS CR
784 BUFFALO R.
185 KETTLE CR
312 OTTER CR
256 BIG CR
2405 GRAND R
7000 WELLAND CANAL
NIAGARA R
202,776
LAKE ERIE
LEGEND
312 - AVERAGE CFS
NOTE: SIZE OF ARROWS ARE PROPORTIONAL TO THE AMOUNT OF FLOW.
SCALE IN MILES
10 5 0 10 20 30

Figure 1-7 – Comparative Water Inputs of Important Tributaries to Lake Erie

TABLE 1-2 RUNOFF STATISTICS FOR TRIBUTARIES OF THE LAKE ERIE BASIN

Stream	Drainage Area (mi.^{2})	Period of Record (years)	Max. Flow (cfs)	Min. Flow (cfs)	Average Flow (cfs)	Average Yield (cfs/mi.^{2})	7-Day Low Flow, 10 yr. Recurrence (cfs/mi.^{2})	7-Day Low Flow, 10 yr. Recurrence (cfs at mouth)	Runoff Precip. (percent)
St. Clair River (Lake Huron outflow)	220,480	106	242,000*	99,000*	187,450				
Clinton River	740	31	21,200	--	470	.635	.052	24	28
Rouge River	467	35	13,000	1.8	235	.503	.033	7.8	22
Huron River (Mich.)	890	19	5,840	4.0	556	.625	.044	24	27
Raisin River	1,125	28	12,900	2.0	714	.635	.027	19.3	28
Maumee River	6,586	40	94,000	20.0	4,794	.728	.013	86	29
Portage River	587	33	11,500	0.3	403	.687	.001	0.6	28
Sandusky River	1,421	39	28,000	4.4	1,021	.719	.010	14.0	28
Huron River (Ohio)	403	15	25,800	2.2	296	.732	--	5.1±	28
Vermilion River	272	15	20,500	0.0	228	.840	--	0.6±	33
Black River	467	21	24,000	0.0	302	.647	--	0.5±	29
Rocky River	294	34	21,400	0.2	273	.929	.004	1.0	35
Cuyahoga River	813	34	24,800	14.0	850	1.045	--	112	39
Chagrin River	267	36	28,000	3.0	333	1.247	.051	4.0	46
Grand River (Ohio)	712	40	21,100	0.0	784	1.101	.003	2.2	40
Ashtabula River	137	34	11,600	0.0	169	1.234	.000	0.0	45
Conneaut Creek	191	28	17,000	0.2	257	1.346	.006	1.2	49
Cattaraugus Creek	436	25	35,900	6.0	705	1.617	.129	55	58
Buffalo River	565	25	35,000	2.8	784	1.388			55
Grand River (Ont.)	2,614	24	47,800	65.0	2,405	.920			36
Big Creek	281	7	3,060	54.0	256	.911			35
Otter Creek	316	13	4,140	10.8	312	.987			37
Kettle Creek	200±	--	2,400±	7±	185±	.902			34
Thames River	2,000±	7	38,500±	58	1,840	.902			36

* monthly average

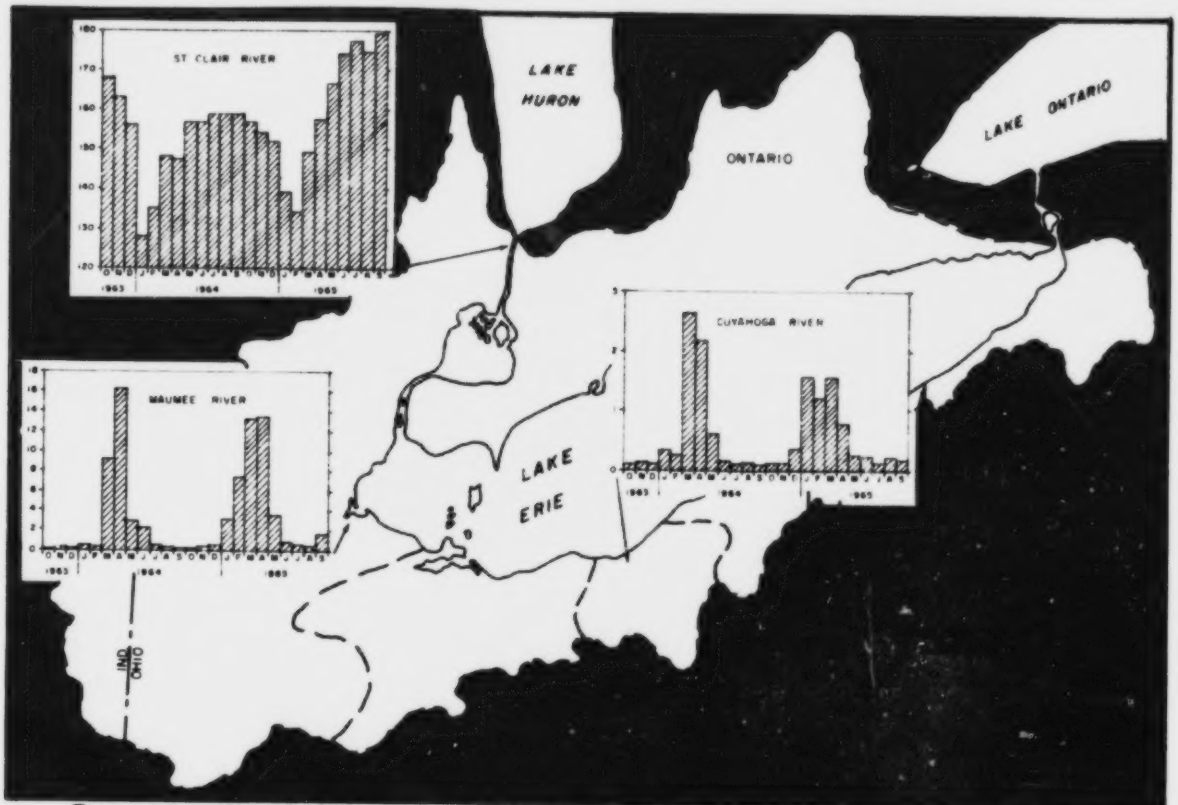

ST CLAIR RIVER
180
170
160
150
140
130
120
1963
1964
1965
MAUMEE RIVER
1963
1964
1965
CUYAHOGA RIVER
1963
1964
1965
LAKE HURON
LAKE ONTARIO
ONTARIO
LAKE ERIE
IND
OHIO

Figure 1-8 – Monthly Tributary Flows to Lake Erie from St. Clair, Maumee, & Cuyahoga Rivers

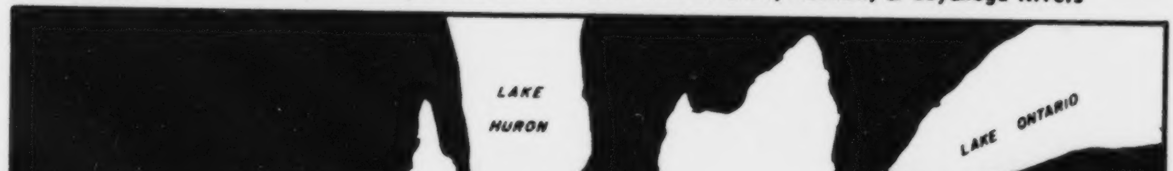

LAKE HURON
LAKE ONTARIO
ONTARIO
LAKE ST CLAIR
LAKE ERIE
MICH
OHIO
IND
OHIO

Figure 1-9 – Lake Erie Basin Ground Water Availability

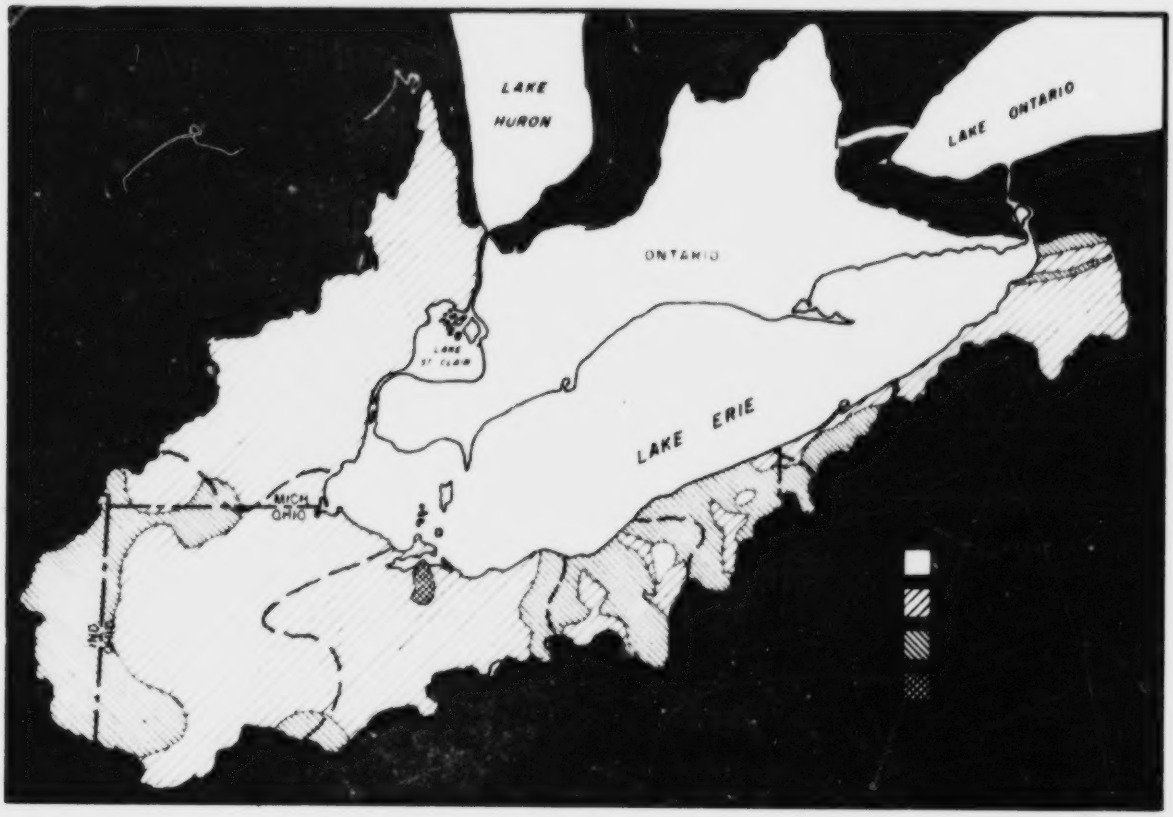

LAKE HURON
LAKE ONTARIO
ONTARIO
LAKE ST CLAIR
LAKE ERIE
MICH
OHIO
IND
OHIO

Figure 1-10 – Lake Erie Basin Ground Water Quality

CHAPTER 2

THE DEMAND FOR WATER

As the population grows in the Lake Erie basin, the demand for high quality water for all purposes will increase accordingly. As more and more leisure time becomes available, the demand by the residents of the basin for high quality recreational water will grow even more. Coupled with the demand for cleaner water and rising with the population will be the need for disposal of waste water. The problem that must be faced will be to change the mounting waste water to forms and amounts not detrimental to water quality.

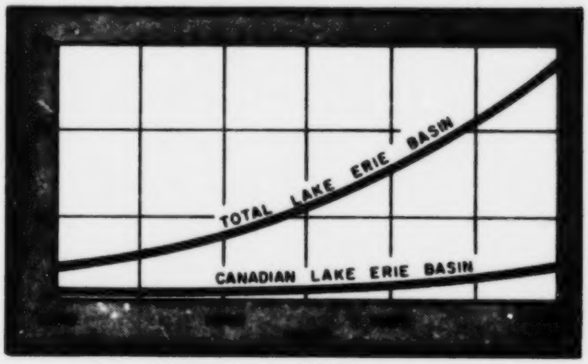


Figure 2-1 – Population Projection

POPULATION

In 1960 nearly ten million persons lived in the United States portion of the Lake Erie basin and 1.2 million in the Canadian portion. The total is expected to increase to more than 27 million by 2020, Figure 2-1. The largest increases are expected to be in those areas which are already densely populated: Detroit, Cleveland-Akron, Fort Wayne, Buffalo, Lorain-Elyria, Toledo, and Erie. The basin population is now 85 percent urban and the percentage will increase. *Since municipal wastes are the greatest degradants to water quality,* the population increase alone is a real threat to Lake Erie's survival.

Lake Erie and its headwaters, the Detroit River, now supply 82 percent or 1,190 million gallons per day (mgd) of the population's water needs (municipal water supply). Figure 2-2 shows the present and projected demand for the entire basin. *High municipal usage is projected to continue to increase with Lake Erie supplying an ever-increasing percentage.* The rate of consumption will increase faster than the population growth rate. The per capita consumption will be accompanied by a commensurate increase in waste volume. *The existing interference to water supply by wastes will become ever more critical.*

INDUSTRY

Industrial growth in the Lake Erie basin is outstripping the population growth and is expected to increase by five times by 2020. About 25 percent of the total production of the five states is within the basin. Total value added by manufacture is more than $17 billion annually.

Preceding page blank

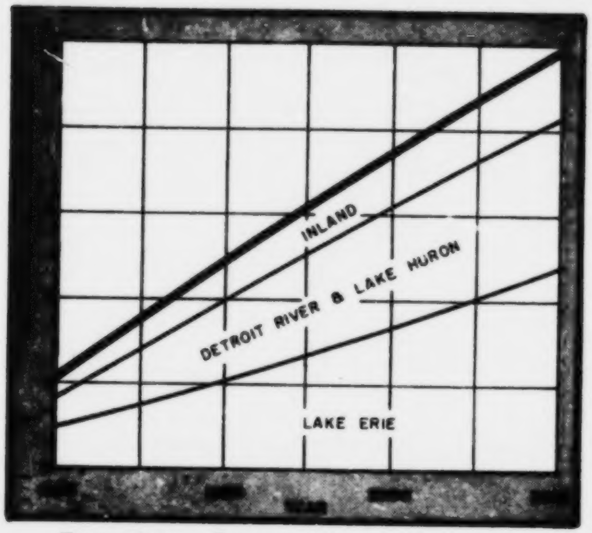


Figure 2-2 – Projected Municipal Water Use

Industrial activity is concentrated in the highly populated metropolitan areas and most is near the lake shore since it relies on a plentiful water supply and waterborne commerce. The chief products of manufacturing are automobiles, fabricated metals, primary metals, rubber, food, petroleum, chemicals, and paper. *Many of the manufacturing processes now produce wastes which are highly detrimental to water quality.*

Present and projected industrial water supply are shown in Figure 2-3. This is self-supplied water and does not include that supplied by municipal systems. The present withdrawal is about 9,600 mgd. Total consumption in 2020 will be 24,000 mgd with Lake Erie and the Detroit River continuing to supply more than three-quarters of the total. Again the very high demand will be accompanied by very high waste volume. *Unchecked wastes will cause progressively greater interference with the uses.*

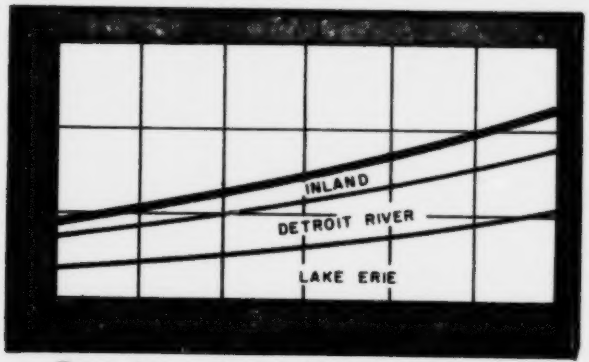


Figure 2-3 – Projected Industrial Water Use

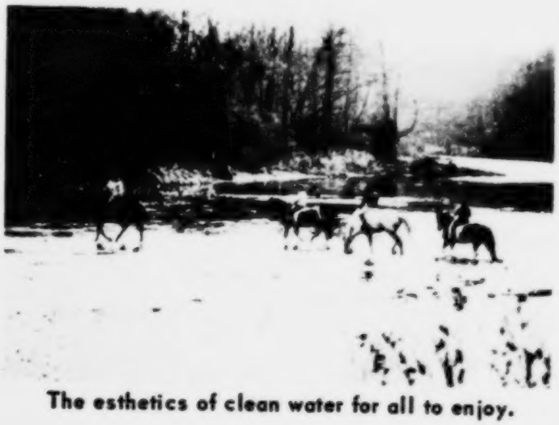
AGRICULTURE

Agricultural production has continued to increase within the basin in relation to the population growth even though actual acreage in production has decreased. Total production is expected to double by the year 2020. Agricultural sales in the U. S. portion of the basin approach $1 billion annually, just over half of which is livestock, and the remainder in crops. The bulk of the activity is in the western part of the basin. *Agriculture produces wastes, the bulk of which are nutrients, and these alone could over the long run ruin Lake Erie if the rate of erosion loss continues unchecked.* This is demonstrated by the fact that, in the past two years, the amount of fertilizer phosphorus used in the basin has increased by more than 15 percent.

Rural water use includes household supply in addition to agricultural uses. Most of the present 124 mgd comes from inland surface and ground water supplies. The consumption will double by the year 2020. There is not now an abundance of water for this use, so that which does exist must be protected from contamination.

TOURISM AND RECREATION

Tourism is a major industry, with Lake Erie being the main attraction. It is probably the most underdeveloped of all industries in proportion to the potential, although it presently adds hundreds of millions of dollars annually to the basin's economy. The largest enterprises are in and near Sandusky, Ohio and Erie, Pennsylvania. The remainder are group endeavors such as the island area and the small resort towns along the lake. State and provincial parks bolster the industry greatly.



The esthetics of clean water for all to enjoy.

Figure 2-4, showing public parks and attendance at major beaches, illustrates the importance of recreation in the Lake Erie basin. Swimming is the single most popular form of recreation, but boating, fishing, and water skiing are also very important. Pollution affects all of these but whole-body contact uses are the most affected, most seriously by waterborne bacteria. Numerous recreation and resort areas have been abandoned or use has been lessened because of pollution.

The few major bathing beaches on Lake Erie receive extensive use.

Recreational activity and the demand for it are increasing greatly and the increase is far greater than the population growth rate. This is illustrated, for example, by the number of pleasure boats on the lake now compared to a few years ago. A warm summer weekend brings over 20,000 boats to Lake Erie.

Although tourism and recreational activity are expanding, pollution of Lake Erie is retarding this growth. *Elimination of pollution will release the potential, and explosive growth may occur.*

FISH AND WILDLIFE

Lake Erie proper is capable of supporting and does support a tremendous fish population although the types have changed to those less desirable. *Quantity of water is not a problem but quality is controlling.* For example, fish can no longer exist in parts of most major tributaries, and some are experiencing diffuculty in the lake proper.

Commercial fishing in Lake Erie was once a thriving industry with some of the largest freshwater fishing ports in the world. Within the last 20 years, correlative with large increases in waste inputs to the lake, commercial fishing has suffered an almost disastrous decline. Prized species such as walleye, blue pike, and whitefish have essentially disappeared. Canadian commercial fishing has offset the decline, in volume, of the U. S. industry by adapting to less desirable species, primarily smelt and yellow perch.

Total catch in pounds is tenuously holding its own, but dollar value is decreasing. Price per pound has been cut in half in the last ten years. Projecting the economic future in impossible, but

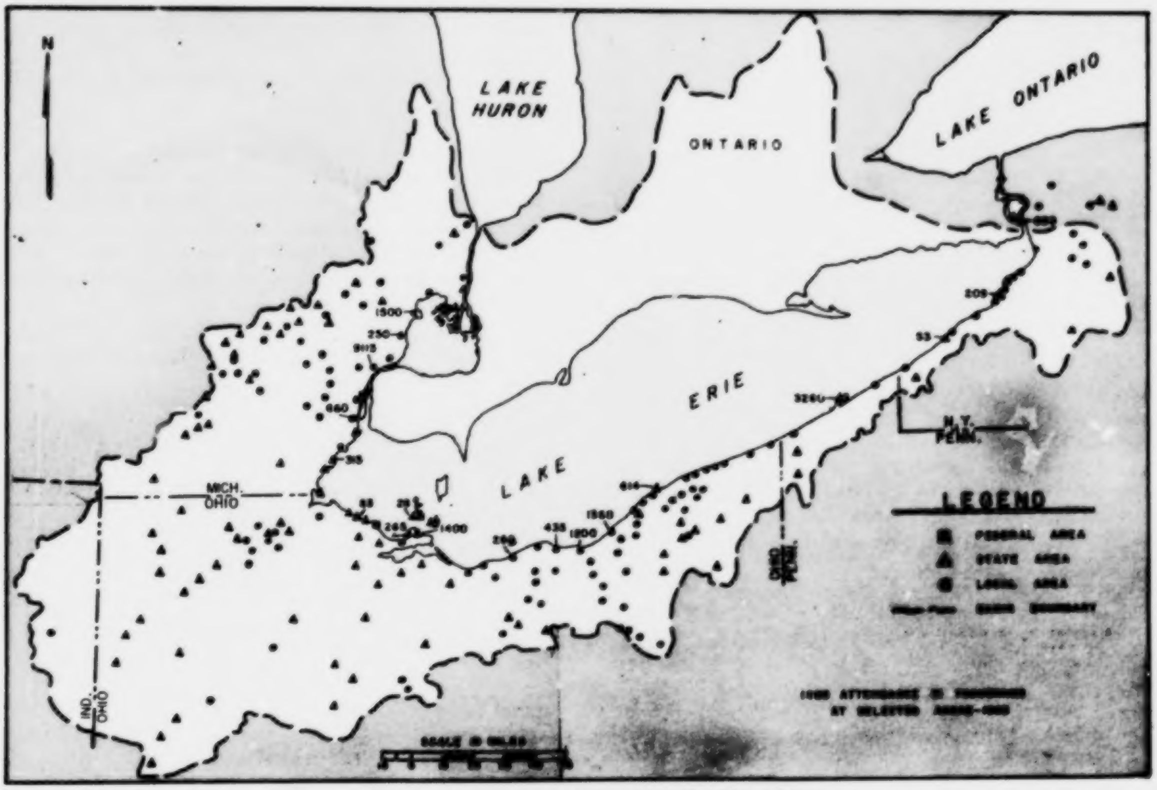


Figure 2-4 – Recreation Areas in Lake Erie Basin

the demand will parallel population growth. It appears that the future is not bright, because restoration of fish populations will take more than pollution control, although this will be the proper beginning.

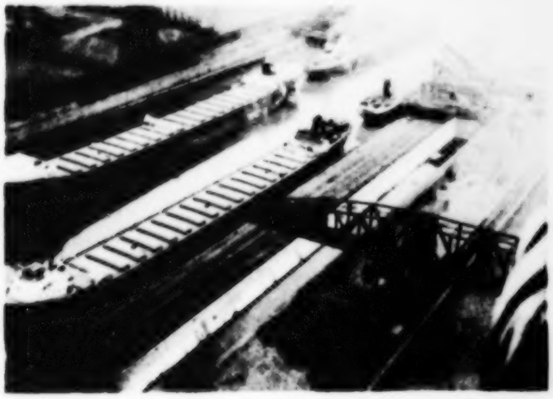
Fishing still exists in many areas; however, often the variety available is limited to a less desirable type.

Wildlife, especially waterfowl, is water-dependent. The marshes in the western part of the basin are important parts of flyways. Most marshes are dependent on the level of Lake Erie. Water quality has not been a serious problem in marshes but it has been in some tributaries where, for example, pollution has killed waterfowl.

Commercial Shipping

The Lake Erie basin is near the commercial center of one of the most industrially productive areas in the world. The availability of the lakes and the St. Lawrence Seaway for waterborne traffic and the restrictive effect of the lake on land routes have made the basin a major distribution center for both raw materials and finished products.

The basin has eleven major U. S. ports: Detroit, Toledo, Sandusky, Huron, Lorain, Cleveland, Fairport, Ashtabula, Conneaut, Erie, and Buffalo. Coal and iron ore are the largest volume commodities, but foreign package trade is also becoming large in tonnage.



Lake Erie accounts for 13 percent of the annual ton-miles of shipping out of a total of nearly 100 billion on the Great Lakes.

Shipping is dependent upon quantity or lake depth. Varying water levels have an economic impact by controlling maximum cargo tonnage. Ships use lake water for cooling, ballast, and potable supply. The potable water use is now equivalent to that of 1,200 persons for eight months of the year. This usage will increase to perhaps double this amount by the year 2020, but this is difficult to predict because of increasing size and efficiency of ships.

Pollution is affecting the potable water use of commercial ships. For example, they have been prohibited by the U. S. Public Health Service from taking water in several areas of the lake unless full treatment is provided. Also, problems have been reported from using highly contaminated harbor waters for ballast.

CHAPTER 3

THE POLLUTION PROBLEM

Lake Erie is not dead but water quality problems exist – they can be deadly – and they are worsening. The evidence is everywhere and obvious to everyone, in the streams, in the lake, and even in the ground water. Unfortunately for Lake Erie the actions to abate this pollution are overdue and they are and have been slow and awkward.

Lake Erie has been variously described as virtually a dead lake and the impression is many times given that it has been completely destroyed by pollution. Other lakes are often described as potentially suffering the "fate of Lake Erie", implying that, once they reach this stage, there is little hope for repair.

Lake Erie is without doubt seriously polluted, but it is certainly not beyond repair. The prospect for improving Lake Erie is very promising if pollution controls are rapidly instituted and if the waste inputs are greatly reduced. However, the time wasted in instituting controls results in a much longer period needed for improvement.

This chapter, by restating briefly the problems which exist in Lake Erie and in its tributaries, attempts to justify the necessary steps to correct the situation. Further justification is given by providing an insight to a dim future if waste inputs continue at or above their present rates.

LAKE PROBLEMS

LAKE ENRICHMENT

Nutritional overenrichment is the single greatest problem in Lake Erie today and presents by far the greatest threat to its future usefulness. It is the problem which, if not corrected quickly, will cause the abandonment of many water uses, including recreation and fishing. In the more distant future it can eliminate Lake Erie as a domestic and an industrial water supply.

Overenrichment is now causing undesirable interference with water supplies, recreation, and fishing. The nutrients are not particularly harmful in themselves, but they have the synergistic effect of resulting in the tremendous overproduction of aquatic plants, especially in the primary microscopic forms. Phosphorus concentrations in the western basin and along the entire south shore are often 20 or more times the amount needed, along with nitrogen, to trigger offensive algal blooms.

The aquatic plants (primarily algae) are a vital part of the food chain which extends up through the fishes to higher animals. When they are grown in superabundance, as they are now in Lake Erie, they break the life balance with a multitude of ramifications. Those ramifications are all to the

Overenrichment by nutrients produces these luxuriant algal growths which have washed onto the Pennsylvania shoreline.

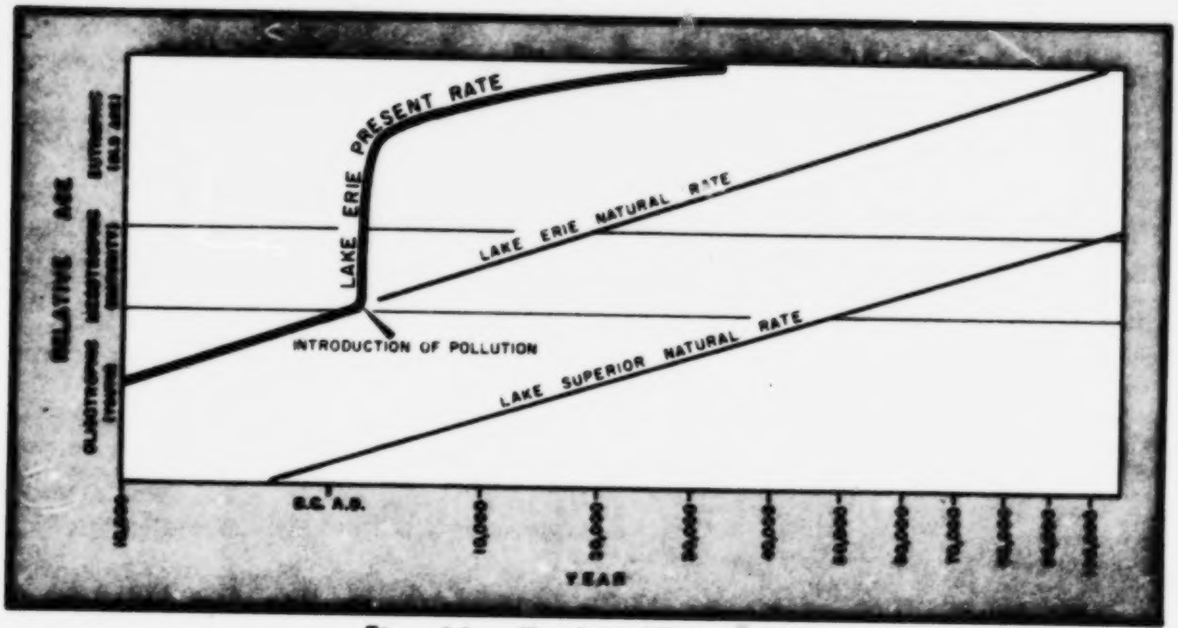


Figure 3-1 – Hypothetical Rates of Aging

detriment of all animals which use the water, including man, and to the lake itself. As long as nutrients keep increasing in an already overenriched environment, the situation will progressively worsen until in the last stages the lake will change to a swampy mass of largely organic detritus.

Any lake will undergo the above changes in time without the presence of man and his wastes. But *without the introduction of wastes the time required for a lake the size of Erie to vanish is almost immeasurably long.* Man can compress and is compressing this time into a relatively very short period (Figure 3-1). He has already, in the past half century, added an estimated 15,000 years to the otherwise natural age of the lake. However he can bring it back nearly to its former state if he tries hard enough and quickly enough. The most effective corrective measure will be the substantial elimination of phosphorus inputs.

The age of a lake is measured by its state of biological productivity. Its rate of aging is measured by the rate of increase in productivity, the rate of change in types of aquatic life, the rate of increase in dissolved chemical content, the rate of decrease in water transparency, and the rate of sedimentation of the lake.

Compared to the other Great Lakes most of Lake Erie has always been in a more advanced state of aging or eutrophication because of its physical characteristics of shallowness, warmth, and high sediment input. At the turn of the century, before man had had any material effect on it, Lake Erie had reached a state of maturity (mesotrophic) as shown in Figure 3-1. The waters and bottom of the lake contained an abundant but still wide variety of life forms. This was the ideal situation, making Lake Erie probably the most valuable of any of the Great Lakes. Once man came on the scene the situation was rapidly altered. The aging indicators (Figure 3-2) all radically departed from their natural course and in only two generations most of the lake advanced to old age. The eastern basin, because of its great depth, has aged less rapidly; but it too is now on the verge of becoming eutrophic.

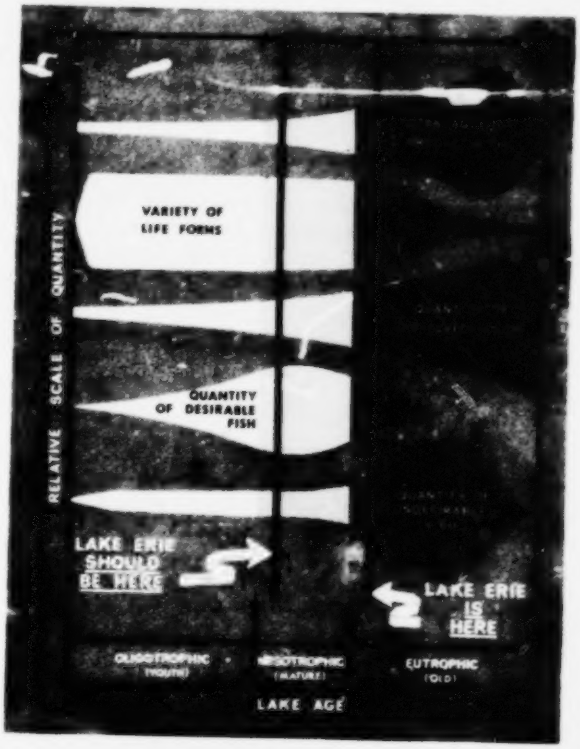


Figure 3-2 – Aging Indicators

The premature aging of Lake Erie has been verified by measurements of many parameters. For example, planktonic algae are decreasing in variety but increasing tremendously in numbers (Figure 3-3). At Cleveland the numbers have increased by 30 times in the past 35 years and similar increases could have been expected elsewhere. Algal blooms in the western basin show ten times the numbers of cells ever found at Cleveland per unit of volume. Algae are becoming dominated by blue-green types. This domination is always an indicator of over-enrichment. Attached algae are also luxuriant. The common attached algae *Cladophora* grow in ever-widening mats in shallow water all along the shores of the lake.

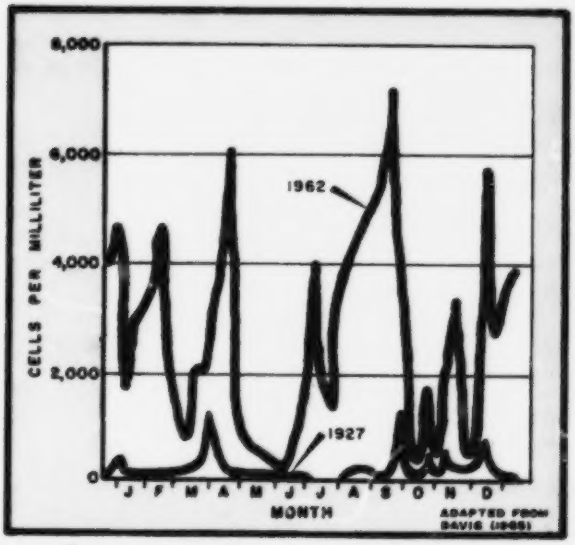


Figure 3-3 – Phytoplankton Abundance at Cleveland Water Intake

Dissolved solids are building up in the lake at a very rapid rate (Figure 3-4), having increased by 30 percent in the past 40 years. Chlorides and sulfates have accounted for most of the increase.

Desirable fish, the prime game and commercial species, such as cisco, blue pike, and walleye, have disappeared or declined drastically (Figure 3-5) while the less desirable and scrub-type fish such as yellow perch, smelt, sheepshead, and carp, have increased sharply.

Bottom organisms in ever-widening places are changing or have changed from a wide variety with relatively few numbers to a narrow hardy variety with very high populations. Tremendous numbers of sludgeworms (up to 30,000 or more per square yard) now inhabit bottom areas which not long ago were dominated by mayflies and other pollution-sensitive invertebrates in numbers two orders of magnitude lower. In the western basin the area dominated by sludgeworms has increased more than 10 times since 1930 (Figure 3-6).

Siltation in Lake Erie is much greater than in the other Great Lakes, but this is of little consequence compared to other destructive factors.

Studies made 40 years ago of the lake by Buckholder recorded no bottom areas seriously depleted of oxygen but recent investigations reveal that severe oxygen deficiencies now clearly occur. Nearly one-fourth of the total lake area now becomes nearly devoid of oxygen in bottom water

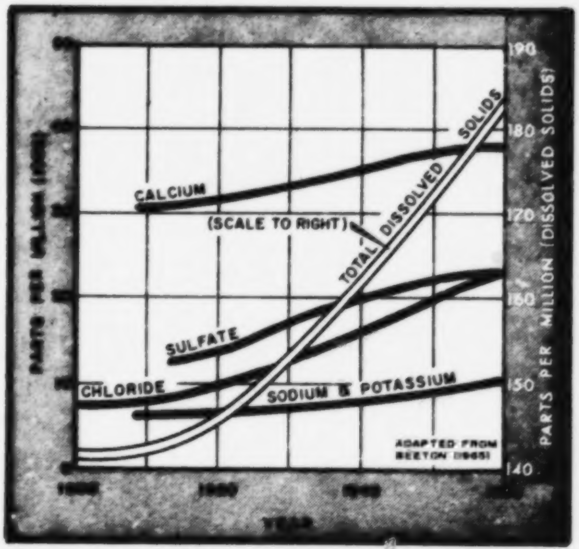


Figure 3-4 – Changes in Chemical Characteristics of Lake Erie

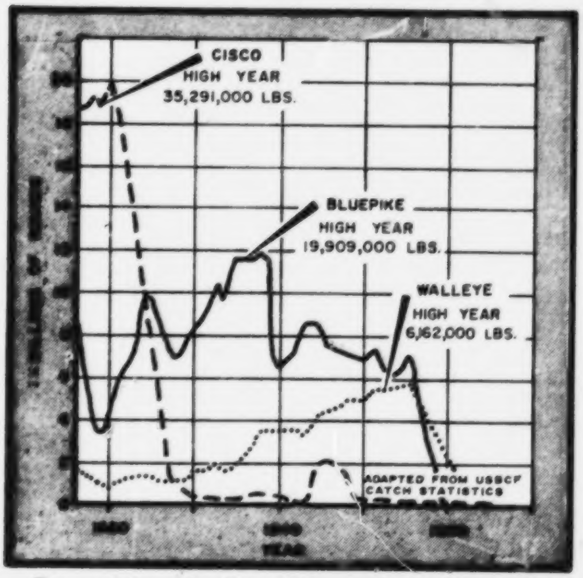


Figure 3-5 – Decline of Desirable Fish in Lake Erie (5 Year Running Average)

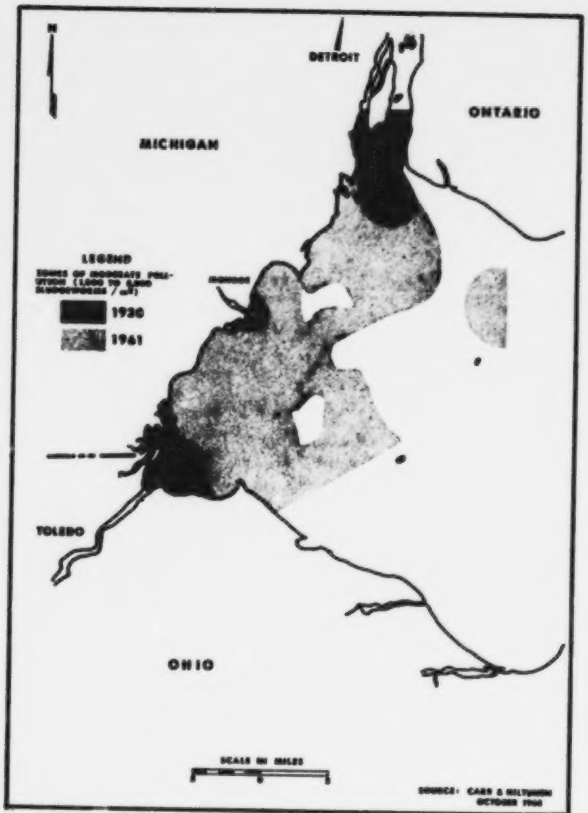


Figure 3-6 – Sludgeworms – Western Basin Lake Erie

during summer thermal stratification and this situation is increasing both in extent and duration of occurrence (Figure 3-7). Oxygen deficiencies also occur intermittently for short periods in the western basin bottom waters.

Some of the oxygen loss in Lake Erie results from the fact that efforts to reduce pollution by means of modern sewage treatment plants have been ineffective; in alleviating one part of the pollution problem, another has gone unabated. Sewage treatment plants, by microbial oxidation, convert organic waste matter to inorganic substance. It has been assumed that these inorganic products of sewage ideally relieved of biochemical oxygen demand (BOD) or organic wastes could be released to Lake Erie without causing any drain on the oxygen resources of the lake. Experience has proven this assumption to be incorrect. Adequate treatment of organic wastes, however, does eliminate most of the immediate oxygen demand which if not removed would be even more destructive.

The total mass of organic waste that reaches Lake Erie each year requires for its conversion to inorganic substances the consumption of about 540 million pounds of oxygen. The recent oxygen losses in the lake can only be partially explained by the action involved in oxidizing organic wastes dumped into the lake. For example, now the oxygen deficit in the bottom waters of the central basin (only 1/9 of the total lake volume) amounts to some 670 million pounds during the summer months. If the organic wastes reaching the lake in a year can

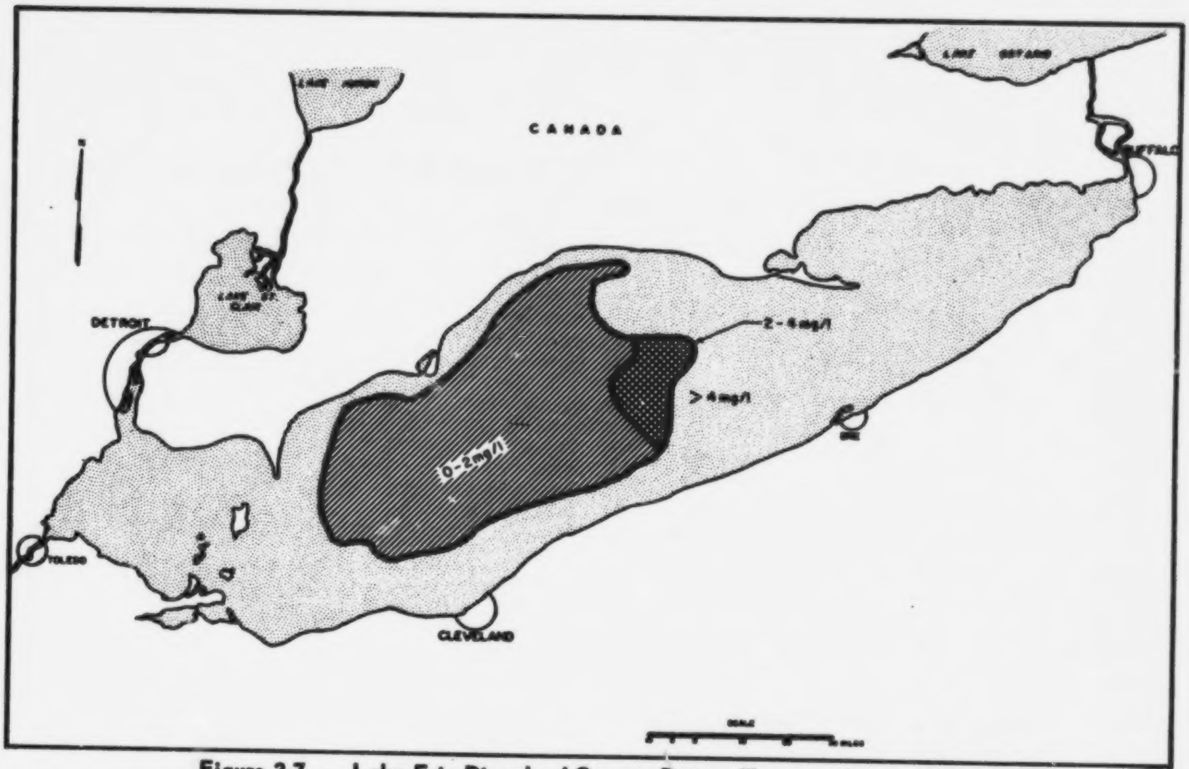


Figure 3-7 – Lake Erie Dissolved Oxygen Bottom Waters – August 1964

account for an assumed consumption of only 540 million pounds of oxygen, obviously there must be a much larger source of oxygen demand somewhere in the lake.

Some of the inorganic products of sewage treatment plants, especially phosphorus, do not, as once believed, flow out of the lake. For example, about 100,000 lbs/day of the phosphorus discharged remains in the lake and is reconverted with carbon, nitrogen, etc. into cellular organic matter which in turn contributes to the huge demand for oxygen that has been so disastrous. The potential oxygen demand that would be generated for the entire lake through productivity of organic carbon is about 9.8 billion pounds annually.

Phosphorus is necessary for the growth of all green plants. Dumped into the lake, it fertilizes the growth of algae that readily convert this inorganic substance into their own organic cell-substance. Fed by this nutrient, algae bloom suddenly and in tremendous proportions in the spring and fall. The superabundant algae die equally fast and sink into the lake fouling it with algal organic matter. The annual BOD resulting from the organic remains of the lake's algae causes an oxygen demand estimated at 18 times greater than that from treated sewage. Thus, the algal resynthesis of organic matter undoes the work of the waste treatment systems and renders ineffective their conversion of waste organic matter to inorganic products. The fateful conclusion is that sewage treatment plants being built today which do not remove substantial nutrients are accomplishing little to save the lake.

Phosphorus and other nutrient and organic matter added to the lake eventually end up on the sediments. Instead of Lake Erie forming a waterway for sending wastes to the sea, it has become a trap that is gradually storing much of the material dumped into it over the years. The nutrients resting in the sediments are relatively innocuous until summer stratification and deoxygenation, when they can come rapidly back into the water to be useful as a plant nutrient again. Therefore it is possible that in a relatively short time the overproductivity of Lake Erie can become self-sustaining because of this ever-increasing reserve. It is also possible that if this alarming process grows, Lake Erie may face a sudden biological cataclysm that will exhaust, for a time, most of the oxygen in the greater part of the lake. Such a catastrophe would make the lake's present difficulties seem mild by comparison. To prevent such a grim fate, it is imperative that the waste input of phosphorus be controlled immediately. Even the present reserve may cause problems for several years.

The ramifications of overenrichment are already well known to most people in the Lake Erie basin. The important point is that they are serious and have the potential of becoming overwhelming with explosive suddenness. *The most critical ramification is the effect on domestic water supply by chemical and biological taste, odors, and colors* along with physical impairment of treatment efficiency by filter clogging. Algae, the direct cause of these problems, also hold the dread potential of concentrating or even creating toxic chemicals. This portent may be affecting fish even now.

Overenrichment is also responsible, in part or in total, for starving fish and adversely affecting their reproduction, and for the declining appeal of algae-covered bathing beaches. In addition are numerous other manifestations, such as fouling of fishing gear, boats, and docks, and the declining esthetic value of the lake's water, and the declining values of shore property.

BACTERIAL CONTAMINATION

The second greatest and most disgraceful problem of pollution in Lake Erie is that caused by bacteria contained in waste inputs. This is a direct health hazard especially near the large metropolitan centers such as Detroit, Cleveland, Toledo, and Buffalo (Figure 3-8). Raw sewage discharged directly to the lake, much of it from combined sewers, is the major source.

Approximately one-third of the United States-Lake Erie shoreline is either continuously or intermittently fouled by bacterial contamination. Many beaches (Table 3-1) are contaminated to some degree. Those near Detroit and Cleveland, encompassing many miles of shore, are many times unfit for use. In these areas coliform concentrations may run as high as a million or more organisms per 100 milliliters (ml), thousands of times greater than safe levels.

The correction of bacterial problems in Lake Erie is relatively straightforward compared to the nutrient problem. Disinfection of wastes is the proper beginning and once this is done, the contamination will subside. However, disinfection does not replace the need for adequate treatment of sewage and control of storm and combined sewer overflows.

OTHER LAKE PROBLEMS

Since Lake Erie has been considered a good disposal site for anything, there are few kinds of waste which cannot be found in it. *Trash and debris, for example, can be seen almost anywhere along the lakeshore.*

Total dissolved chemicals, as indicated previously, are rapidly approaching concentrations which will be detrimental. Chlorides, for instance, have tripled in the lake since 1910, and stand at a level of 25 milligrams per liter (mg/l).

Cause for concern exists in regard to the quantity of pesticides (originating mainly in agricultural areas) and other complex organic chemicals being discharged to the lake. These can be toxic to fish and potentially toxic to man.

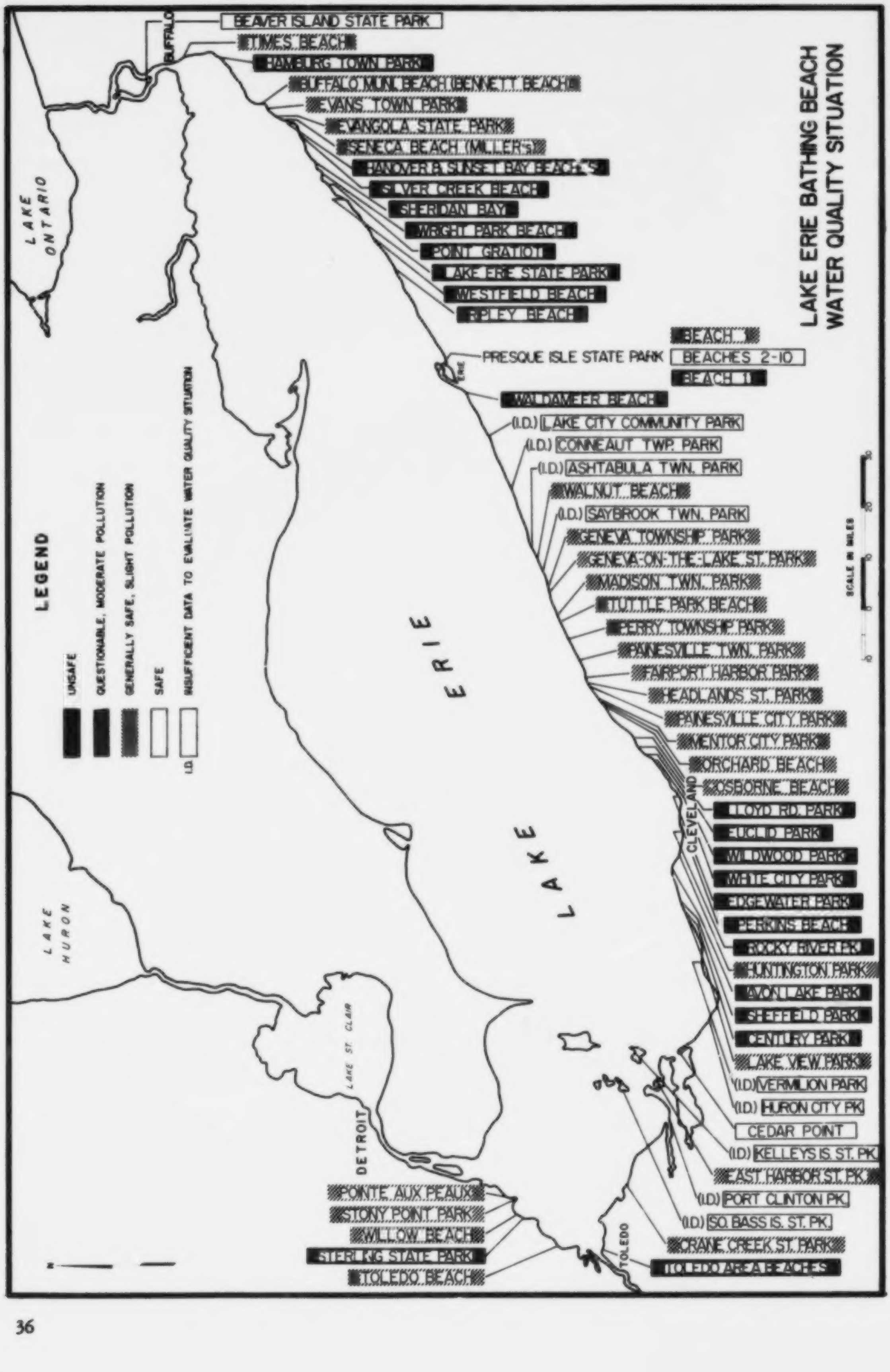

LAKE ERIE BATHING BEACH WATER QUALITY SITUATION
LEGEND
UNSAFE
QUESTIONABLE, MODERATE POLLUTION
GENERALLY SAFE, SLIGHT POLLUTION
SAFE
I.D. INSUFFICIENT DATA TO EVALUATE WATER QUALITY SITUATION
SCALE IN MILES
LAKE ONTARIO
LAKE HURON
LAKE ST. CLAIR
LAKE ERIE
BUFFALO
ERIE
CLEVELAND
DETROIT
TOLEDO
BEAVER ISLAND STATE PARK
TIMES BEACH
HAMBURG TOWN PARK
BUFFALO MUNI. BEACH (BENNETT BEACH)
EVANS TOWN PARK
EVANGOLA STATE PARK
SENECA BEACH (MILLER'S)
HANOVER & SUNSET BAY BEACH'S
SILVER CREEK BEACH
SHERIDAN BAY
WRIGHT PARK BEACH
POINT GRATIOT
LAKE ERIE STATE PARK
WESTFIELD BEACH
RIPLEY BEACH
PRESQUE ISLE STATE PARK
BEACH 1
BEACHES 2-10
BEACH 11
WALDAMEER BEACH
(I.D.) LAKE CITY COMMUNITY PARK
(I.D.) CONNEAUT TWP. PARK
(I.D.) ASHTABULA TWN. PARK
WALNUT BEACH
(I.D.) SAYBROOK TWN. PARK
GENEVA TOWNSHIP PARK
GENEVA-ON-THE-LAKE ST. PARK
MADISON TWN. PARK
TUTTLE PARK BEACH
PERRY TOWNSHIP PARK
PAINESVILLE TWN. PARK
FAIRPORT HARBOR PARK
HEADLANDS ST. PARK
PAINESVILLE CITY PARK
MENTOR CITY PARK
ORCHARD BEACH
OSBORNE BEACH
LLOYD RD. PARK
EUCLID PARK
WILDWOOD PARK
WHITE CITY PARK
EDGEWATER PARK
PERKINS BEACH
ROCKY RIVER PK.
HUNTINGTON PARK
AVON LAKE PARK
SHEFFIELD PARK
CENTURY PARK
LAKE VIEW PARK
(I.D.) VERMILION PARK
(I.D.) HURON CITY PK.
CEDAR POINT
(I.D.) KELLEYS IS. ST. PK.
EAST HARBOR ST. PK.
(I.D.) PORT CLINTON PK.
(I.D.) SO. BASS IS. ST. PK.
CRANE CREEK ST. PARK
TOLEDO AREA BEACHES
POINTE AUX PEAUX
STONY POINT PARK
WILLOW BEACH
STERLING STATE PARK
TOLEDO BEACH
N

Figure 3-8 – Lake Erie Bathing Beach Water Quality Situation

TABLE 3-1

WATER QUALITY OF LAKE ERIE BATHING BEACHES

Unsafe	Questionable Moderate Pollution	Generally Safe Slight Pollution	Safe
		MICHIGAN	
	Sterling State	Pointe Aux Peaux Stony Point Willow Toledo	
		OHIO	
Toledo Area Rocky River Perkins Edgewater White City Wildwood Euclid Lloyd Road	Century Sheffield Lake Avon Lake	Crane Creek State East Harbor State Lakeview Huntington Metro. Osborne Orchard Mentor City Painesville City Headlands State Fairport Harbor Painesville Township Perry Township Tuttle Madison Township Geneva-on-the-Lake State Geneva Township Walnut	Cedar Point
		PENNSYLVANIA	
	Presque Isle State (Beach No. 11) Waldameer	Presque Isle State (Beach No. 1)	Presque Isle State (Beaches Nos. 2-10)
		NEW YORK	
Westfield Silver Creek Hamburg Town	Ripley Lake Erie State Point Gratiot Wright Sheridan Bay Hanover Beach & Sunset Bay	Seneda (Millers) Evans Town Evangola State Buffalo Municipal Times	Beaver Island State

Insufficient data available to evaluate water quality at the following beaches: South Bass Island State, Port Clinton City, Kelleys Island State, Huron City, Vermilion City, Saybrook Township, Ashtabula Township, Conneaut Township in Ohio and Lake City Community in Pennsylvania.

Potential threats to the purity of Lake Erie waters are the effects of artificially added heat from anticipated power plants and other industries, oil from spills and from proposed drilling in the lake, brine from drilling, and additional exotic chemicals and toxic metals from industry.

Last but not least, the very *waste treatment processes themselves have a pollution potential which must be reckoned with, and that is the ultimate disposal of the materials removed from waste water.*

TRIBUTARY PROBLEMS

SOUTHEAST MICHIGAN AREA

The deleterious effect of man upon his environment is particularly evident in the Southeast Michigan area (Figure 3-9). *The highly useful crystal clear waters of exceptional quality in Lake Huron become so polluted as they pass through the Detroit metropolitan complex that when they enter Lake Erie they are deprived of much of their usefulness for recreational and water supply purposes.* The

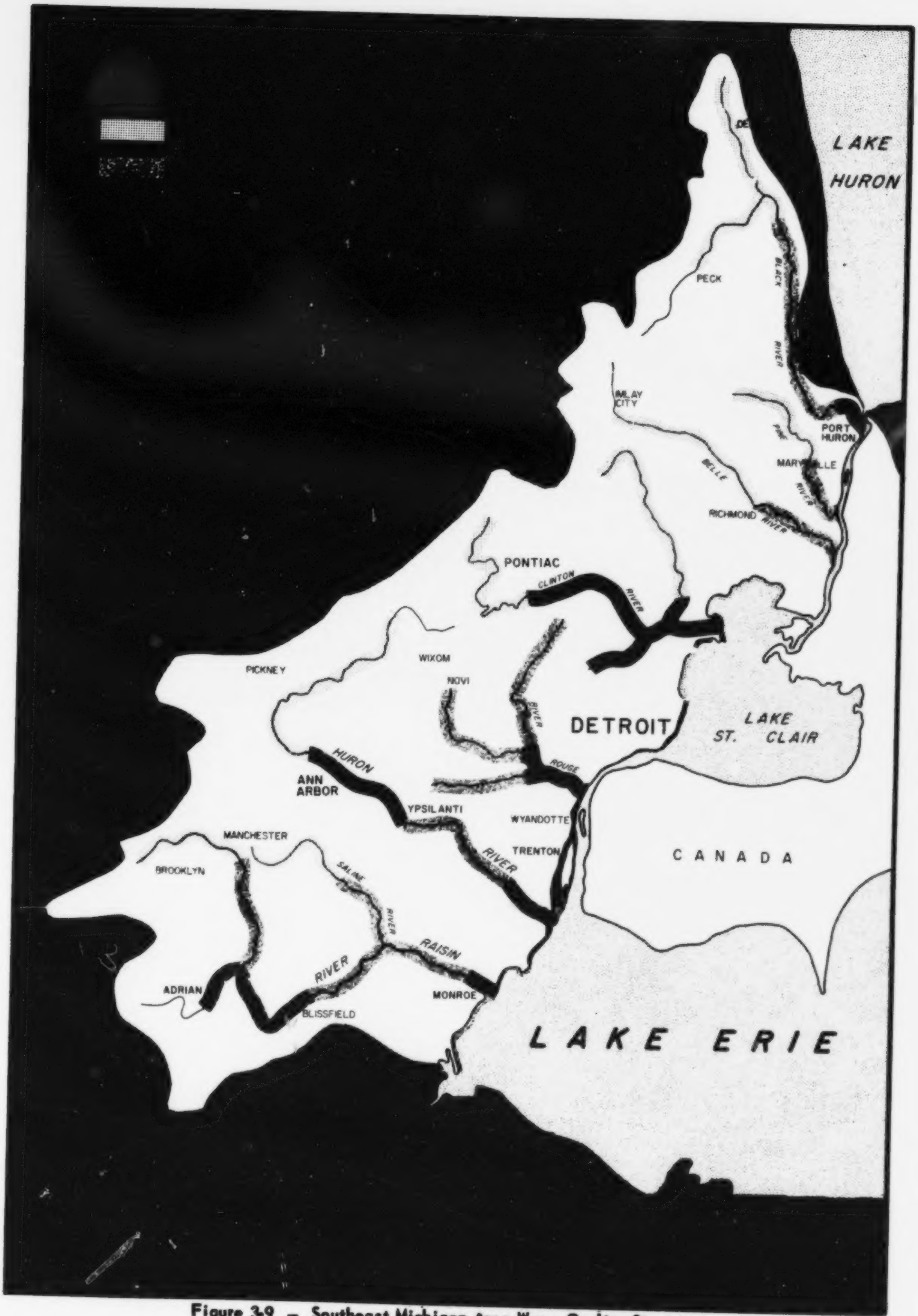

LAKE HURON
PECK
BLACK RIVER
IMLAY CITY
PINE
PORT HURON
MARYSVILLE
BELLE RIVER
RICHMOND
PONTIAC
CLINTON RIVER
WIXOM
NOVI
PICKNEY
RIVER ROUGE
DETROIT
LAKE ST. CLAIR
HURON RIVER
ANN ARBOR
YPSILANTI
WYANDOTTE
TRENTON
CANADA
MANCHESTER
BROOKLYN
SALINE RIVER
RAISIN RIVER
ADRIAN
BLISSFIELD
MONROE
LAKE ERIE

Figure 3-9 – Southeast Michigan Area Water Quality Situation

condition of the waters is mirrored in the adjacent property with the exclusive mansions located at the headwaters where the water is cleanest. Masses of rotting algae wash ashore along with industrial wastes, further fouling the shoreline.

Lake Huron is quite low in nutrients, but *the Detroit River is the single most important source of nutrients and other harmful materials causing the eutrophication of Lake Erie.* Two-thirds of all phosphorus which enters Lake Erie originates from this area.

The City of Detroit and Wayne County sewerage systems are the major source of phosphorus and oxygen-demanding wastes poisoning Lake Erie in addition to causing local defilement. This area by itself empties such tremendous quantities of contaminants into the lake that these discharges by themselves if unabated would suffice to maintain the present eutrophication and fish problems of the lake.

Combined sewer overflow to the Detroit River exert a high oxygen demand and contribute extensive nutrients to Lake Erie.

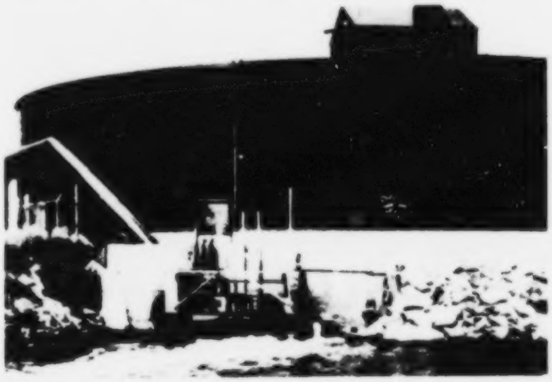
ST. CLAIR RIVER

Only occasional elevated values of coliforms and phenols are found in the main channel and generally the water quality is good in the St. Clair River. The high phenol concentrations are caused by the petroleum complex in Canada at Sarnia, Ontario, and the elevated coliform concentrations result from pollution entering the St. Clair River from its tributaries, the Black, Pine, and Belle Rivers.

LAKE ST. CLAIR

Extensive pollution problems occur along sections of the U. S. shoreline, although the open waters of Lake St. Clair generally are of good water quality. The sources of major pollution to the Lake St. Clair shoreline are the Clinton River, the Milk River drain, and the numerous storm water and sanitary sewer overflows along the heavily populated Michigan shoreline. These discharges contaminate the waters and endanger swimmers in the area. An example of this is at Metropolitan Beach, a large recreational area located near Mt. Clemens, Michigan, which is occasionally contaminated by high coliform discharges from the Clinton River. However, effective management by Macomb County officials minimizes the bathers' contact with contaminated water.

Effluent from the City of Pontiac's two sewage plants produces severe pollution in the upper Clinton River. The lower river from the City of Rochester to the mouth is also polluted by inadequately treated wastes from numerous cities. Red Run, a notoriously polluted Clinton River tributary, traverses a heavily populated area of suburban Detroit and receives large quantities of raw sewage through discharges from overloaded combined sewer systems during certain storm water periods.



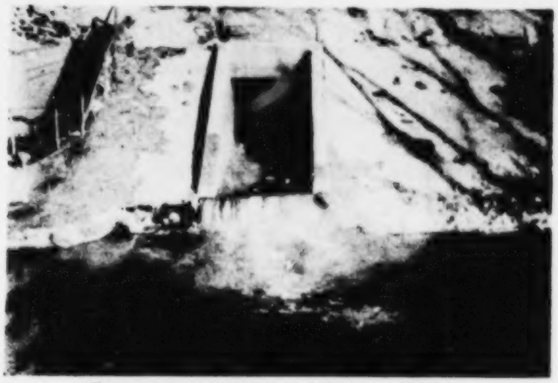
Discharge at McLouth Steel Corp. to Detroit River

DETROIT RIVER

The water quality of the Detroit River is discussed in detail in the report "Report on Pollution of the Detroit River, Michigan Waters of Lake Erie, and Their Tributaries" by the Federal Water Pollution Control Administration. Since that study the Michigan Water Resources Commission has obtained stipulations or agreements with 23 individual municipal and industrial polluters to upgrade the quality of their effluents to recommended levels by 1970.

Excluding electric power production, more than 1,800 mgd of wastes (1,100 mgd from industry and 700 mgd from municipal sewage) are added to the Detroit River, changing it from a relatively clean stream at its head to the basin's largest carrier of wastes as it enters Lake Erie.

The City of Detroit's main sewage treatment plant, serving more than 90 percent of the people in the Detroit area, contributes 95 percent of the municipal waste to the Detroit River and is the largest source of phosphorus, suspended solids, phenols, oil, inorganic nitrogen, and biochemical oxygen demand material in the entire Lake Erie *basin.* Overflow from combined sewers in Detroit and its suburbs, carrying both storm water and raw sewage, also contributes greatly to the pollution load in the river.



Raw sewage bypass to Rouge River.

In the upper Detroit and Rouge Rivers, Great Lakes Steel, Allied Chemical, Ford Motor, and Scott Paper are the major sources of industrial wastes. Downriver industries contributing significant quantities of wastes are Great Lakes Steel, McLouth Steel, Pennsalt Chemical, and Wyandotte Chemical.

Two municipal water intakes, the City of Detroit's Fighting Island supply, and particularly that of Wyandotte, are endangered by the high bacterial counts of the river.

Pollution from sewage discharges to the lower Detroit River makes all forms of water contact sports hazardous along both the United States and Canadian shoreline. Dissolved oxygen levels are approaching the danger point near shore at the mouth of the river. The low DO levels together with bottom sludge deposits, oils, and toxic materials threaten fish, migratory birds, and other wildlife. Extensive dredging of sludge is required annually in the Rouge River and at the mouth of the Detroit River to maintain navigation.

HURON RIVER

Initial degradation of the Huron River occurs below the primary sewage plant at Dexter. Below the Ann Arbor-Ypsilanti area the river is further degraded to the point where with the additional wastes added by Flat Rock, the river never recovers and suffers from excessive pollution or enrichment throughout the remainder of its course. This degradation is particularly noticeable in a series of man-made impoundments downstream which are continually choked with algae and other aquatic plants.

Water quality in the Huron River and lakes upstream from Ann Arbor is reasonably good and the river and lakes are used by bathers in the summer and ice fishermen in the winter. The cities of Ann Arbor and Flat Rock use the Huron River for their water supply. Flat Rock's water supply is adversely affected by upstream waste discharges.

RAISIN RIVER

In its last three miles, the Raisin River receives the primary sewage plant effluent of Monroe, five paper mill effluents which contain high coliform concentrations and a BOD population equivalent of 225,000 and 1,000 lbs/day of cyanides from the Ford Motor Company. The lower Raisin River is frequently devoid of dissolved oxygen, resulting in a continuous state of putrefaction during the summer months. Deposits of settleable solids interfere with ship movement to the extent that annual dredging is required.

Below Manchester, the river is overenriched and algal blooms occur throughout. The south branch and hence the main channel become further degraded below Adrian.

The Brest Bay beach area, a series of unsewered communities just north of the Raisin River mouth, discharges septic tank wastes to Brest Bay. The contamination from these wastes is intensified when rains are heavy.

The combined effect of the City of Monroe's municipal wastes, paper mill wastes, and the Brest Bay beach area discharges has resulted in polluted bathing conditions at Sterling State Park. Pollution-stimulated algal growths have forced Monroe to move its water supply intake point to avoid unpleasant tastes and odors in the water supply.

MAUMEE RIVER BASIN

The copious algal growths which exist almost throughout the Maumee River basin indicate what lies ahead for Lake Erie if the pollutional loading, particularly phosphorus, is not stemmed.

The Maumee River, an interstate stream, ranks third among the tributaries, just behind the Cuyahoga, in its effect on Lake Erie. Yearly, over four million pounds of phosphorus, two million tons of silt, in addition to oils, phenols, sewage, refractory chemicals, and oxygen-demanding wastes, pass through the Maumee River into Lake Erie. Municipal, agricultural, and industrial sources all share in this fouling.

Figure 3-10 depicts the present water quality in the Maumee River basin. From waters that were once useful and free of harmful substances, *some tributaries have been defiled to the point where, in several sectors, few if any legitimate uses can be made of the waters.* Swimming and boating are impaired. Many cities and a number of industries experience taste and odor problems, or other fouling in their water supplies.

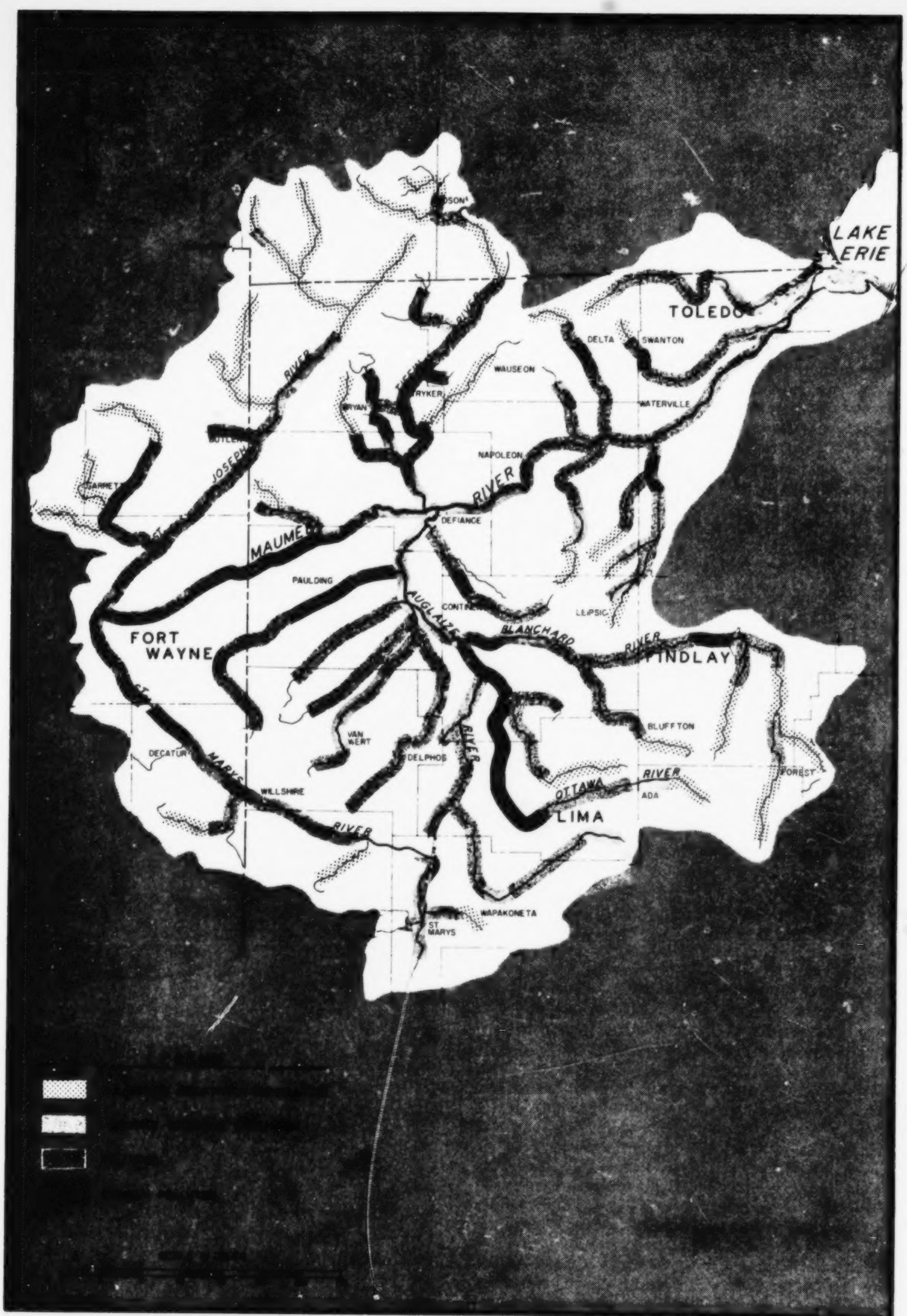

LAKE ERIE
TOLEDO
DELTA
SWANTON
WAUSEON
WATERVILLE
NAPOLEON
RIVER
DEFIANCE
MAUMEE
ST JOSEPH RIVER
BRYAN
STRYKER
PAULDING
FORT WAYNE
AUGLAIZE
RIVER
BLANCHARD
RIVER
FINDLAY
LEIPSIC
BLUFFTON
VAN WERT
DELPHOS
DECATUR
ST MARYS
RIVER
WILLSHIRE
OTTAWA
RIVER
ADA
LIMA
FOREST
WAPAKONETA
ST MARYS

Figure 3-10 – Maumee River Basin Water Quality Situation

UPPER MAUMEE RIVER

The Maumee River is polluted at its very source, the confluence of St. Marys and St. Joseph Rivers in Indiana. Septic tank and raw sewage discharges from Waynesdale and other suburban Fort Wayne communities produce bacterial contamination and oxygen depletion affecting both the St. Marys and Maumee Rivers. This defilement is soon compounded by the inadequately treated effluent from Fort Wayne's sewerage system. In the past, high phenol concentrations have been discharged by industries to the river directly and through Fort Wayne's sewage plant. In winter months these phenols have persisted for many miles downstream, producing tastes and odors in municipal water supplies.

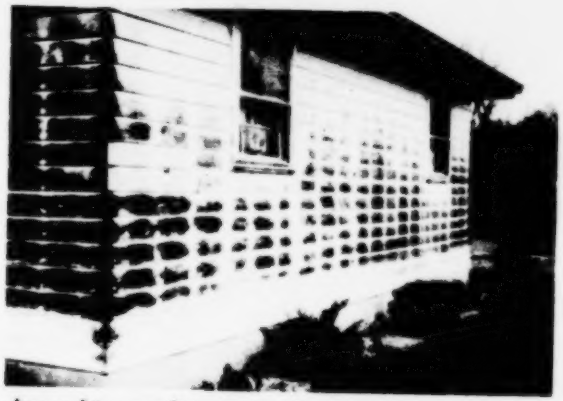
Algae are abundant in the St. Marys and Maumee Rivers throughout the year, and the St. Joseph River downstream from municipalities. Increasing algal growth, associated with taste and odor problems, has been recorded throughout this area. Plating wastes have caused fish kills in Cedar Creek, a tributary to the St. Joseph River. The Kitchen-Quip Company at times still discharges toxic concentrations of heavy metals. The Tiffin and upper St. Joseph Rivers generally maintain good water quality except below several small cities and industries.

AUGLAIZE RIVER

At Wapakoneta, Ohio, the Auglaize River receives the effluents from the sewage treatment plant, two packing companies, and a bottling plant. The stream bottom, scoured clean of silt and organic deposits during the spring, is covered with black, septic, foul-smelling sludge by July. The Auglaize River is again degraded below its confluence with the Ottawa and Blanchard Rivers. Low or negligible oxygen concentrations exist, while large quantities of ammonia, acrylonitriles, and other oxygen-demanding wastes are present. Extensive algae, other nuisance aquatic plants, and oxygen-demanding wastes are present throughout these areas. Substantial fish kills occur, especially in winter when wastes are not readily broken down.

During low flow periods the Ottawa River, below Lima, Ohio, is composed entirely of the effluent from Lima's sewage plant and Sohio's refinery, chemical, and petrochemical plants. The entire flow above these waste discharges is diverted to augment Lima's water supply. The Ottawa River shows little signs of recovery after leaving Lima, and severe chemical and bacterial pollution exists along the remainder of its course.

On the Blanchard River below Findlay, Ohio only pollution-tolerant aquatic organisms were found to exist. Downstream from Ottawa's inadequately treated sewage discharge, the Buckeye Sugar Company has in the past discharged large quantities of oxygen-demanding sugar beet wastes. These wastes have produced complete anaerobic conditions in the Blanchard River and caused homes and fences painted with lead-based paint to turn black.



Anaerobic conditions in the Auglaize River produced hydrogen sulfide which produced a black stain on this house.

LOWER MAUMEE RIVER

In the City of Defiance, Ohio, the Maumee is further degraded by the addition of the highly polluted Auglaize River water, the raw sewage discharge of large numbers of unsewered or faulty sewered areas, and the inadequately treated sewage from the Defiance plant. Due to faulty design, the Defiance sewage treatment plant is closed whenever

Interlake Steel outfall to lower Maumee River.

the river rises above a certain stage, thus bypassing raw sewage between 30 and 60 days each year. In addition, large concentrations of phenols from industrial sources are continuously discharged by this plant.

Cities situated on or near the Maumee River draw their raw water supply from the highly polluted waters of this stream. Taste and odor problems are prevalent throughout much of the year in the water supplies at Defiance, Napoleon, Bowling Green, and, at times, Toledo. At Defiance, during periods of low temperature and ice cover, taste and odor problems are encountered due to phenolic compounds. The finished water has a medicinal taste and odor. During the period of spring runoff, the water has an intense earthy or musty taste. In late spring the water has been described as musty, moldy, earthy, fishy, and rotten.

The taste and odor problems at Napoleon are similar to those at Defiance, however larger doses of chlorine are required due to ammonia wastes from the Auglaize River. Campbell Soup Company has reported excessive taste and odor problems at times but it is able to remove them with extensive treatment. Large concentrations of ammonia at the plant have created peak chlorine demands as high as 150 mg/l. The company reports that the quality of its raw water supply has continued to deteriorate in recent years.

Toledo's sewage treatment plant and partially combined sewer system are both overloaded. Raw sewage and settled sewage sludge are frequently bypassed to the Maumee River. As a result, water-oriented recreation in the Toledo area is hazardous. *Adequate recreational facilities are lacking because of these contaminated waters. Wastes, storm bypasses, and runoff degrade Toledo's raw water supply* under certain adverse conditions even though the intake is in Lake Erie, several miles from the City. In addition to the wastes from the City of Toledo itself, industrial wastes are discharged which contain oil, phenols, solids, color, BOD, and chemical oxygen demand (COD). The following contribute oil or phenols: Standard, Pure, Gulf, and Sun Oil Companies, and Interlake Steel. Lake level fluctuations affect the Maumee River as far as 15 miles upstream; therefore, pollution which enters the Maumee River at one point in the lake-affected area may degrade the water quality for some distance upstream as well as downstream.

Toledo STP effluent.

NORTH CENTRAL OHIO AREA

Nutrients and low dissolved oxygen concentrations are the major causes of water quality problems within the North Central Ohio Area. Phosphates, nitrates, and other nutrients cause the luxuriant growths of floating and attached algae which in places produce taste and odors in raw water supplies, combine with debris to choke streams, and along with sewage form septic sludge deposits along the water courses and beaches. Fish kills are prevalent, and waterfowl kills from oils continue. Dissolved oxygen depletions are common below many waste outfalls. Figure 3-11 shows the present water quality during low flow periods.

SANDUSKY RIVER

With the present inadequate treatment provided municipal, agricultural, and industrial wastes, and the lack of treatment of storm runoff from urban areas, *the Sandusky River never completely recovers before it is again degraded by further waste loadings.* It suffers from pollution or enrichment from its headwaters at Crestline to its mouth at Sandusky Bay. Trash and garbage dumps are common along the banks and flood plains, and in places the channel is completely clogged with logs and debris. Oil slicks and depressed oxygen levels below Crestline and Fremont are caused in part by Northern Ohio Sugar, Pioneer Rubber, and the Pennsylvania Railroad. Fish are killed by agricultural and industrial toxicants, and a lack of dissolved oxygen.

An excellent example of control of pollution from agricultural sources exists in the Celeryville area on the Sandusky River. In this area where severe sheet erosion and flooding previously occured, the waters are now retained for later use in irrigation or are conveyed by subsurface drainage to nearby water courses.

BLACK RIVER

Toxic materials such as cyanide and chromium, in addition to oil, solids, etc. discharged by General Motors and Republic Steel divest the Black River in Elyria of its life-sustaining properties. Elyria, Oberlin, and the numerous surrounding developing urban areas plague the river with raw or inadequately treated sewage. Between Oberlin and Lorain only the most pollution-tolerant organisms are found and numerous fish kills occur. Below Elyria the river is often depleted of oxygen, covered with oil slicks, and multi-colored from industrial and other wastes during low flow. Upstream, the river is green with algae and covered with the scum of aquatic plants. In the lower section, the wastes from the City of Lorain and U. S. Steel's Tubular Operations add to the already polluted conditions of the river. In the upper reaches brines from oil well

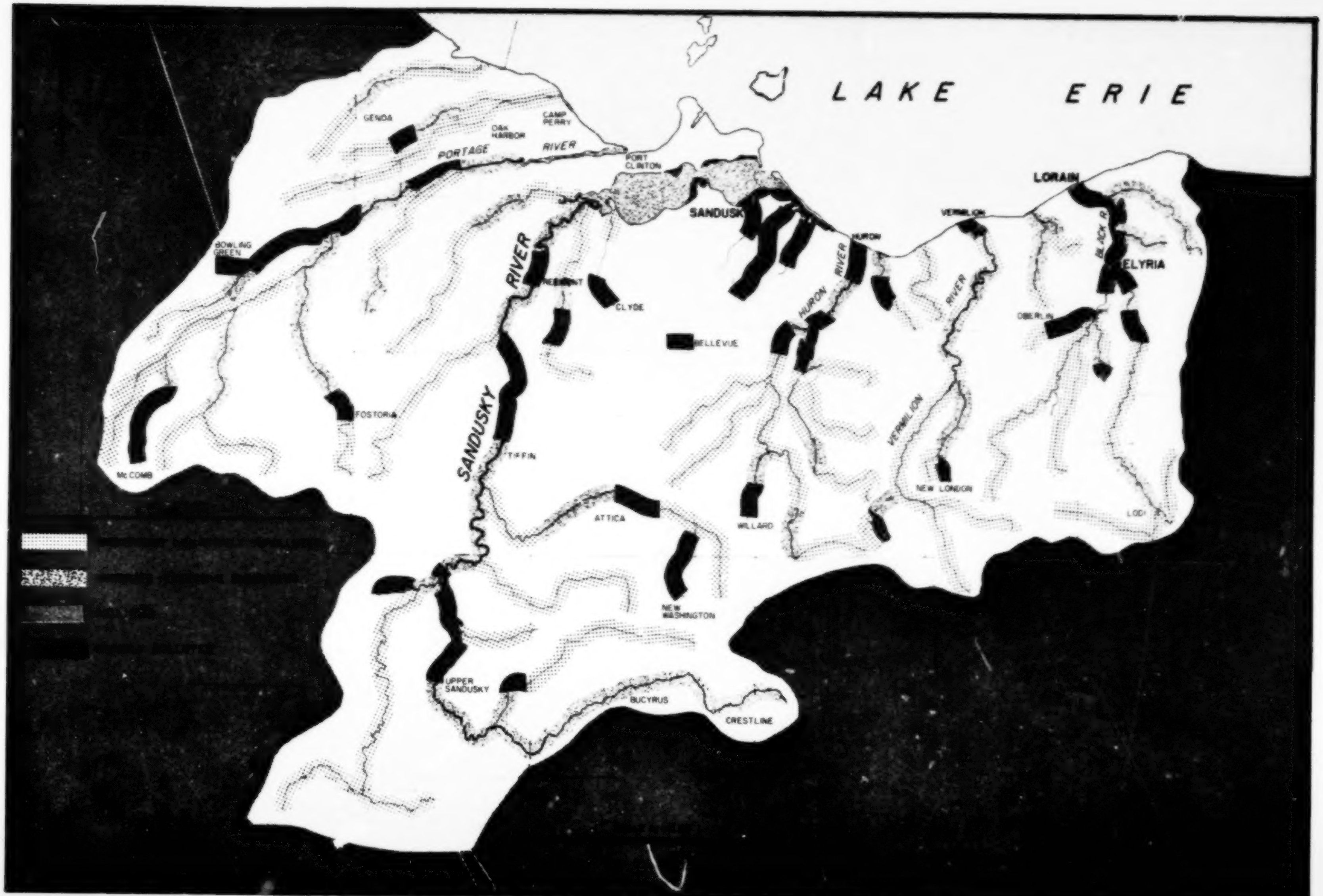

LAKE ERIE
GENOA
OAK HARBOR
CAMP PERRY
PORTAGE RIVER
PORT CLINTON
SANDUSKY
LORAIN
BLACK R.
ELYRIA
OBERLIN
VERMILION
HURON
HURON RIVER
VERMILION RIVER
BOWLING GREEN
FREMONT
CLYDE
BELLEVUE
FOSTORIA
SANDUSKY RIVER
TIFFIN
McCOMB
ATTICA
WILLARD
NEW LONDON
LODI
NEW WASHINGTON
UPPER SANDUSKY
BUCYRUS
CRESTLINE

Figure 3-11 – North Central Ohio Area Water Quality Situation

operations produce high dissolved solids concentrations and oils have been spilled to the river from breaks in the Buckeye Pipeline Company's transmission line.

PORTAGE RIVER

Profuse floating and attached algal growths fed by phosphorus and nitrates from agricultural runoff, and municipal treatment plant and septic tank effluents trouble the Portage River waters. These nuisance algal conditions and dissolved oxygen deficits interfere with use of the Portage River as a raw water supply and for recreation. Duck kills from oils have been reported. Below Fostoria the river is often an oily, turbid white or rust color from wastes discharged by Seneca Wire, and Swift and Company. Foster Duck Farm and Hirzel Canning discharge high oxygen-consuming wastes. Numerous small cities are located on tributaries which have virtually no flow half the year. Therefore, little capacity exists for assimilating wastes.

OTHER TRIBUTARIES

Oil slicks on the Huron River from the Baltimore and Ohio Railroad Yards at Willard are found at times all the way to Lake Erie. Oil discharges also have been reported from ruptures in the Buckeye Pipeline Company's transmission line. Wastes from Stokely-Van Camp, agriculture in general, and numerous cities produce areas devoid of oxygen and areas with floating and attached algal growths.

Gross pollution with bacterial contamination, scum, profuse algal growth, and septic sludge and muck exist in a number of small tributaries. In the Sandusky, Amherst, and Sheffield-Avon areas this gross pollution and potential health hazard is particularly evident, where not only does it cause oxygen and bacteriological problems in the receiving stream, but it serves as a source of contaminants to nearby bathing beaches as the streams enter the lake.

Oil, chromium, oxygen demand, color, solids, etc. are discharged in part or total to area waters by Bechtel-McLaughlin, Central Soya, Hirzel Canning, Norfolk & Western Railroad, and U. S. Gypsum.

The City of Bellevue is unique in that it discharges untreated domestic and industrial wastes to underground caverns. As a result, the ground waters here and in the downstream area are excessively contaminated.

LAKEFRONT

Decomposing algae and coliform organisms foul and contaminate many beaches within the area. However, Cedar Point, East Harbor and Crane Creek State Parks, and Kelleys and Bass Islands normally maintain acceptable water quality even though algal problems exist. *The major defiling of beaches from rotting algae and aquatic plants occurs from Toledo to Sandusky*, including the island area. These extensive algal growths are caused by the excessively high nutrient content and suitable bottom conditions of the western Lake Erie basin.

The beaches immediately adjacent to Toledo are polluted by the Maumee River, storm and combined sewer overflows, the effluent and bypassing from the Toledo treatment plant and local sources. The Lucas County Health Department does not recommend swimming at any of the beaches within the county except at Crane Creek State Park. The Lorain City Health Department has recommended that Lakeview Park and Century Park beaches be closed due to high coliform concentrations. The Lorain County Health Department recommends that there be no swimming in the Sheffield Lake-Avon Lake area. Near river and stream mouths, pollution is high. Enteric pathogens have been found in the lower sections of all major rivers in this area with the exception of the Portage River. Storm water overflows, combined sewers, and sewage treatment plant bypassing during rainfalls carry untreated sewage into several bathing areas.

GREATER CLEVELAND-AKRON AREA

Many miles of *waterways within the Greater Cleveland-Akron area are grossly polluted, and this area is second only to Detroit in its effect on Lake Erie.* Most waterways throughout the Metropolitan Park Systems are either esthetically objectionable or constitute a definite health hazard. The clean pure waters which still exist in some sectors of the basin, particularly in the upper Cuyahoga and Chagrin Rivers, are fast becoming degraded by the expanding urbanization of the Cleveland and Akron area. In places, the waters are choked with debris, rotting organic masses, oils, garbage and other municipal and industrial wastes. With the exception of Huntington Park, all bathing beaches along the Lake Erie shoreline in this area are, without question, polluted. Figure 3-12 depicts the present water quality of this area.

CUYAHOGA RIVER

The *lower Cuyahoga River and navigation channel throughout the Cleveland area is a virtual* waste treatment lagoon. At times, the river is choked with debris, oils, scums, and floating organic sludges. Foul smelling gases can be seen rising from decomposing materials on the river's bottom. Viewed from the city's observation towers, the river appears to be chocolate-brown or rust-colored. During most of the year this lower section has no visible life, not even low forms such as leeches and sludgeworms which usually thrive on wastes.

The inadequately treated wastes from the Cleveland Southerly Treatment Plant, and an undetermined number of storm water overflows and sewage bypasses discharge large quantities of oxygen-demanding wastes and bacterial contamination, including numerous species of enteric pathogens, to the lower river.

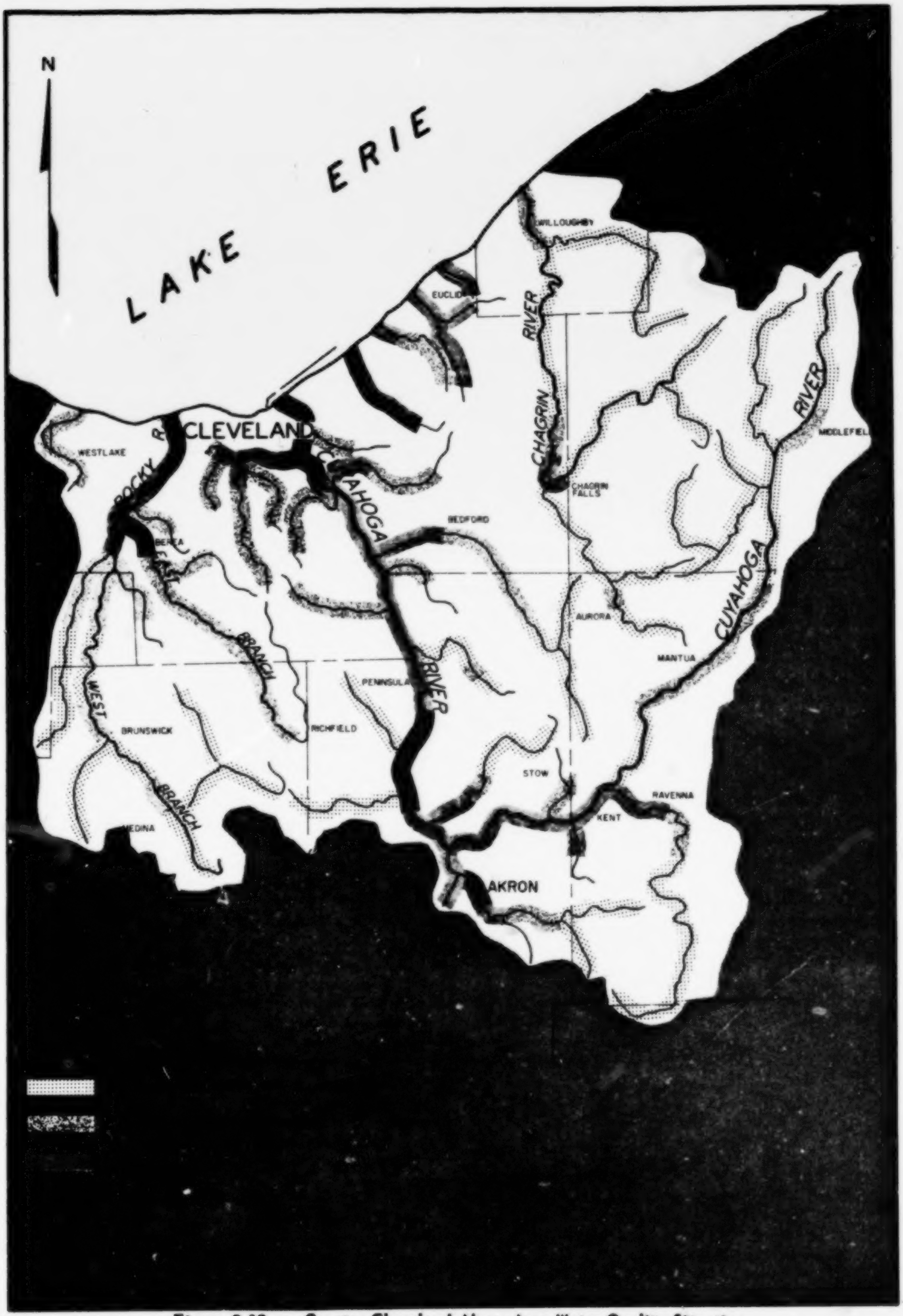

N
LAKE ERIE
WILLOUGHBY
EUCLID
CHAGRIN RIVER
CHAGRIN FALLS
CUYAHOGA RIVER
MIDDLEFIELD
CLEVELAND
WESTLAKE
ROCKY R
CUYAHOGA
BEDFORD
BEREA
EAST BRANCH
WEST BRANCH
RIVER
AURORA
MANTUA
PENINSULA
RICHFIELD
BRUNSWICK
MEDINA
STOW
RAVENNA
KENT
AKRON

Figure 3-12 – Greater Cleveland-Akron Area Water Quality Situation

Highly discolored and polluted wastes are discharged to Lake Erie by the Cuyahoga River.

These domestic wastes are joined by the discharges from the major industrial complex in the Cleveland area. Republic Steel, U. S. Steel, and Jones and Laughlin discharge solids, iron, oil, sulfates, ammonia, acids, and other deleterious materials. Harshaw Chemical Company discharges solids, nickel, fluorides, and acids.

In the upper Cuyahoga River, little if any dilution water is available to assimilate the waste discharged by Akron, Kent, Ravenna, and the industrial complex located within this area, since the City of Akron diverts the entire low flow of the river. The effluent and bypassing of Ravenna's sewage treatment plant, and particularly the numerous businesses, motels, and homes along Breakneck Creek, pollute this waterway. Below where this creek enters the Cuyahoga River, the river is gray-brown with an abundance of aquatic plants along the shoreline and floating algae on the surface. Downstream the discharges from Lamson and Sessions and Sonoco Products yield a reddish tinge, high oxygen demand, and oils. Gross pollution exists at all seasons of the year from this area of the river to the mouth.

Firestone, B. F. Goodrich, Goodyear Tire Division, Goodyear Aerospace Division, and Diamond Salt all discharge wastes to the Little Cuyahoga River in Akron, seriously degrading its water quality. During low flow the odor and oxygen demand imparted to the receiving waters can be detected as far downstream on the Cuyahoga River as Peninsula, Ohio. The rubber plants' wastes contain color, odor, oils, solids, complex organics, high temperatures, and oxygen-demanding materials. Goodyear Aerospace effluent contains heavy metals, cyanides, and other toxic materials. Diamond Salt discharges chlorides to the Ohio Canal and to the Akron treatment plant which cannot treat this waste.

In its headwaters, the Cuyahoga River is relatively unpolluted and is used as a water supply for the City of Akron and surrounding areas. Although this area is now relatively undeveloped, it is projected that within the next 10 to 20 years this area will become urbanized. With increased urbanization water quality degradation will occur unless active measures are taken to maintain a pure supply. Even now wastes from the Smallwood Packing Company, the City of Middlefield, and other developing areas at times depress the river's oxygen content and produce algal growths.

ROCKY RIVER

Numerous small inadequate treatment plants dot Rocky River's watershed and severely degrade its water quality. *There is no area-wide collection or treatment system within the basin* and this relatively continuous urban area is served by many major treatment plants which provide inadequate treatment. The main stem, the East Branch, and the lower West Branch support prolific algal growths. In the summer, much of the stream bottom is covered with rotting masses of unsightly algae which, at times, produce foul odors. Most of this area with foul water quality is within the Cleveland Metropolitan Park system and the offensive state of the waters interferes with park uses. This is particularly evident below Berea. Dumps along the stream banks and flood plains in the Columbia Station and other areas, as well as numerous septic tank effluents and misused storm drains, pollute the waters in the unsewered areas. Near the yacht clubs and marinas floating sludge and sewer gas bubbles are evident.

The City of Berea presently depends upon Baldwin and Coe Reservoirs for its municipal water supply. These waters are generally highly enriched and contain high algal, sediment, and iron concentrations. At times, during low flow periods, Berea diverts the total flow of the East Branch.

Sediments also interfere with water uses in this area. These sediments originate mainly from subdivision and highway construction. Ordinances to control sediment from subdivision construction are either lacking or not enforced. In new contracts being let by the Ohio Department of Highways, a stipulation has been included which requires the prevention, control, and active abatement of pollution during construction. The Cleveland Metropolitan Park Board has had to dredge extensively to maintain adequate depth in several of its recreational reservoirs.

LAKEFRONT

Bacteria, color, debris, suspended solids, oxygen-consuming materials, dead fish, etc., all are found along Cleveland's front door – the Lake Erie shoreline. Unlike many cities, which are able to rid themselves of garbage and wastes by discharging them to a nearby river for someone else to worry about, Cleveland's wastes fester in front of them.

Along with inadequately treated wastes from all Cleveland area treatment plants, combined sewer and storm water overflows pour bacterial contamination onto the shore. Even during dry weather, raw sewage continuously overflows from Cleveland's overloaded combined sewer system. This raw sewage and other wastes all are found in the excessively polluted local bathing beaches. A Cleveland resident must travel 60 to 100 miles to find lakefront beaches unquestionably suitable for swimming.

IF YOU
MUST
SWIM here
DON'T SWIM FOR AN HOUR AFTER EATING
NEVER SWIM ALONE
DON'T SWIM IN WATER COLDER THAN
DON'T SWIM IF YOU HAVE HEART TROUBLE
SWIM ONLY AT PATROLLED BEACHES
JOHN

NORTHEAST OHIO AREA

Severe chemical pollution exists in the lower reaches of both the Grand and Ashtabula Rivers and in places along the lakeshore. Locally the waters are stained green, yellow, milky white, and brown. Several raw or inadequately treated discharges of municipal wastes also degrade the streams' water quality. Water quality at most lakefront bathing areas remains relatively good except after rains. Figure 3-13 depicts the present water quality in the Northeast Ohio Area.

GRAND RIVER

The Grand River in its lower reach is one of the most chemically polluted waterways within the Lake Erie watershed. The Diamond Shamrock Company discharges over 3,000 tons of dissolved solids daily to the river which flows to Lake Erie. The Painesville and Fairport sewerage systems discharge poorly treated wastes which, along with septic tank effluents from Grand River and Painesville Northeast, produce heavy bacterial pollution within this sector.

At times the lower river is brightly colored, ranging from bright green to yellow which results from chemical discharges. Untreated sewage has also been observed floating on the surface. Three other industries, Calhio Chemical, Uniroyal, and A. E. Staley, discharge significant wastes within the area.

The upper Grand River generally maintains good water quality.

CONNEAUT CREEK

Algal growths and bacterial pollution are found in the vicinities of Conneautville and Springboro, Pennsylvania from raw untreated discharges in Conneautville and inadequately operated septic tanks in Springboro. The Corps of Engineers, in a flood control study, reports the discharge of raw sewage from sewer pipes in Conneautville. Putrid sludge deposits are found below Springboro and in an unnamed creek which receives septic tank effluents and the treated wastes of the Albro Packing Company. Conneaut Creek is of good water quality as it crosses the Ohio-Pennsylvania state boundary. In Conneaut the creek receives the poorly treated wastes from the municipal treatment plant.

The Pennsylvania Fish Commission stocks Conneaut Creek with trout in several upper portions where excellent water quality exists.

ASHTABULA RIVER

Strong chemical and medicinal odors accompany the ever-present milky white or brown discoloration of Fields Brook, a tributary of the lower Ashtabula River. These conditions are caused by a large industrial complex comprised of Cabot Titania, Reactive Metals, Detrex Chemical, Olin Mathieson. General Tire, and Diamond Shamrock, Semi-Works, which discharge organic and inorganic wastes to the river with Fields Brook as an intermediary stream. Within the Ashtabula area bacterial pollution exists from unsewered residential areas and from raw sewage discharged by dock activities and vessels.

Above the Ashtabula complex, the river exhibits good water quality and supports good fishing.

PENNSYLVANIA AREA

Foam, foul odor, and black-brown discoloration are much in evidence for ten miles downshore from Hammermill Paper Company's discharge to Lake Erie under the prevailing westerly winds. These wastes inhibit the development of this area. With prolonged winds from the east, extensive treatment must be provided to Erie's raw water supply to prevent severe finished water taste and odor problems caused by these wastes. Under these same meteorological conditions the color, foam, and objectionable odors make the beaches at Presque Isle State Park esthetically offensive.

The water quality at Presque Isle State Park is generally excellent with median coliform concentrations on Beaches 2-10 of under 100 organisms per 100 ml. However, Beach 11 and occasionally Beach 1 have water quality problems. Beach 11 is polluted from sewage treatment plant bypasses, combined and storm sewer overflows, a bird sanctuary, and Hammermill's discharge. Lower coliform concentrations in the summer of 1967 may have resulted from the increased chlorination of Erie's effluent. An unsewered area west of Presque Isle pollutes Beach 1, and Beachcomber-Kelso Beach area. Algal problems are prevalent in the shore areas both east and west of Presque Isle, and to an extent on Presque Isle itself. Several of the small beaches east of Erie are contaminated, and others are of unknown quality.

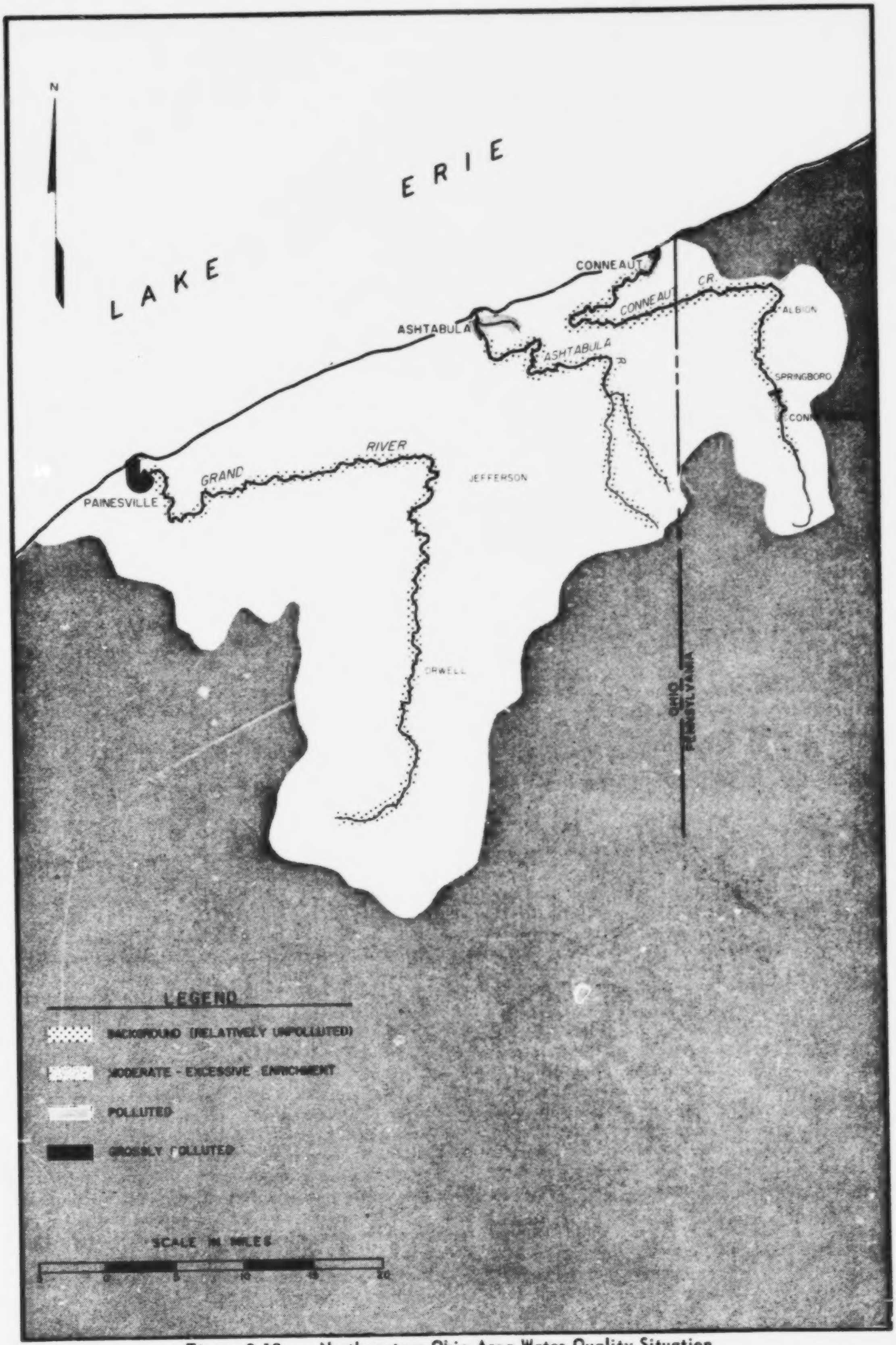

N
LAKE ERIE
CONNEAUT
CONNEAUT CR.
ASHTABULA
ASHTABULA R.
ALBION
SPRINGBORO
CONN
GRAND RIVER
PAINESVILLE
JEFFERSON
ORWELL
OHIO
PENNSYLVANIA
LEGEND
BACKGROUND (RELATIVELY UNPOLLUTED)
MODERATE - EXCESSIVE ENRICHMENT
POLLUTED
GROSSLY POLLUTED
SCALE IN MILES
5
0
5
10
15
20

Figure 3-13 – Northeastern Ohio Area Water Quality Situation

The Pennsylvania streams within the Lake Erie watershed are relatively small. The most polluted of the streams are Cascade Creek, Garrison Run, and Mill Creek. These streams flow through Erie to the harbor and receive the combined sewer overflow and storm water discharges from the Erie collection system. Bottom deposits in the harbor at the mouth of these creeks are a brownish-black combination of mud, silt, and detritus. Sewage and chemical odors emanate from sediments taken from the bottom inside and outside the harbor. The City of Girard discharges poorly treated wastes to Elk Creek. The Lake City plant has previously discharged inadequately treated wastes to Elk Creek but the Pennsylvania Health Department reports that required improvements have been made. Gunnison Brothers Tannery degrades the water quality of Brandy Run and a section of Elk Creek with its waste discharges.

The remainder of the streams within the Pennsylvania area generally are of good water quality.

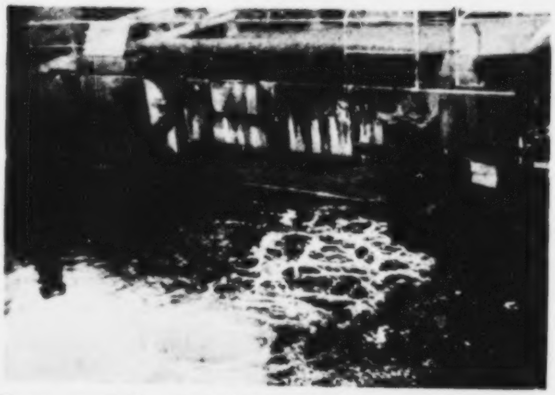
NEW YORK AREA

The waters of this area vary from *essentially concentrated industrial and municipal wastes in one river which is devoid of all biological life*, to several small streams which support stocked trout. Bathing beaches must be cleaned daily to prevent masses of rotting, foul smelling algae from accumulating. Bacterial contamination also exists in a number of the bathing areas, although several fairly good swimming beaches exist. Figure 3-14 depicts the present water quality of the major streams in the New York area.

BUFFALO RIVER

The Buffalo River is a repulsive holding basin for industrial and municipal wastes under the prevalent sluggish flow conditions. It is devoid of oxygen and almost sterile. Oil, phenols, color, oxygen-demanding materials, iron, acid, sewage, and exotic organic compounds are present in large amounts. Residents who live along its backwaters have vociferously complained of the odors emanating from the river and of the heavy oil films. In places the river's surface is a boundless mosaic of color and patterns resulting from the mixture of organic dyes, steel mill and oil refinery wastes, raw sewage, and garbage. Thick films of oil are present on the Buffalo River at all times except during flood conditions. In addition to upstream sources, oil is discharged directly to the river by Mobil Oil, Republic Steel, and Donner-Hanna Coke. During times of high flow, these oils, along with the other contaminants are flushed into the Niagara River where they interfere with water intakes, and recreational and wildlife uses.

The effect of Lake Erie on the level and flow of the river extends upstream for over six and one-half miles. As a result, during periods of low flow, wastes which enter this sector may travel both upstream and downstream from the point of discharge.



Waste outfall of Allied Chemical, Buffalo Dye Division.

Cazenovia, Cayuga, and Buffalo Creeks, all tributary to the Buffalo River, are rapidly defiled as they enter the metropolitan area. However, in their upper reaches they retain good water quality, and support trout and other fish populations. Enrichment is prevalent in outlying areas as evidenced by the copious mats of aquatic plant and algal growth. Resulting decomposing sludge banks, in places, choke stream flow. Phosphorus and other nutrients which promote these growths are provided by septic tank and small inadequate treatment plant effluents, raw sewage discharges, and agricultural runoff. Stream degradation is particularly evidenced in and below East Aurora, West Seneca, Gardenville, Lancaster, and Depew. Garbage dumps, such as the Village of Depew's, are abundant along the watercourses. Oil wastes which originate from the Pennsylvania Railroad shops are flushed to Buffalo Creek during heavy rains. These oils contribute to the major slicks and films which are present on both the Buffalo and Niagara Rivers.

The five major industries on the Buffalo River have recently completed a cooling water supply intake into Lake Erie which will also provide somewhat increased flow in the lower sector of the Buffalo River. This additional flow, along with the many other corrective measures presently underway, should reduce the gross pollution which now exists. But much more will be needed to accomplish effective abatement.

CATTARAUGUS CREEK

Cattaraugus Creek resembles an open sewer after receiving wastes from Peter Cooper Corporation and Moench Tanning Company in Gowanda. Besides containing oils, toxicants, and solids, these wastes exert an oxygen demand equal to the raw sewage from a city of 200,000. In spite of the high reaeration rate of the stream, only pollution-tolerant sewage bacteria, blue-green algae, sludgeworms, and bloodworms are found. At one time these waters were capable of supporting trout and other desirable fish as well as having an excellent water contact sport potential. Now the water is highly turbid and dirty gray in color. Foul smelling sludge

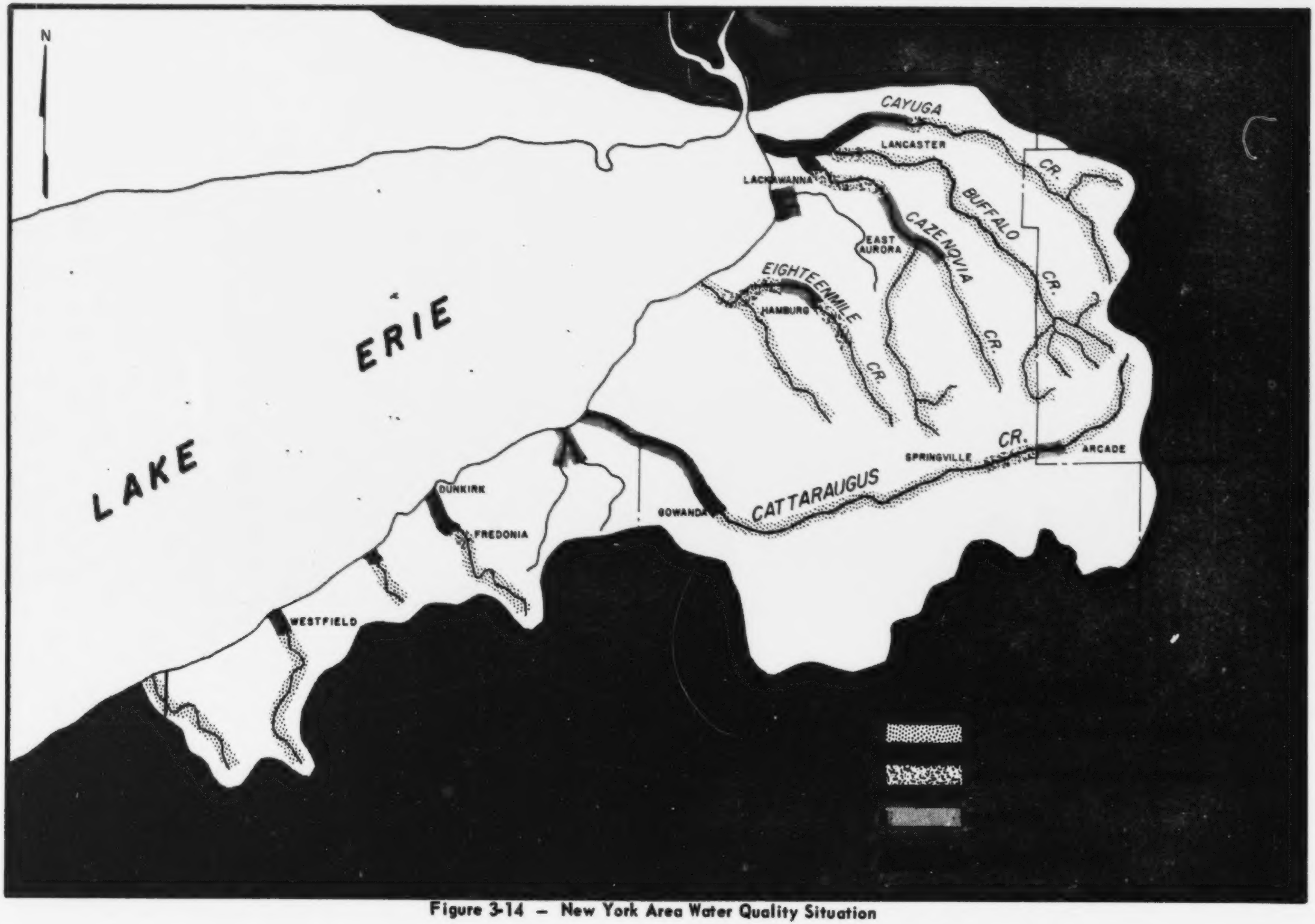

N
LAKE
ERIE
CAYUGA
LANCASTER
CR.
BUFFALO
CR.
LACKAWANNA
CAZENOVIA
CR.
EAST
AURORA
EIGHTEENMILE
HAMBURG
CR.
CATTARAUGUS
CR.
SPRINGVILLE
ARCADE
GOWANDA
DUNKIRK
FREDONIA
WESTFIELD

Figure 3-14 – New York Area Water Quality Situation

banks exist throughout the twenty miles to Lake Erie. These conditions are further aggravated by cannery wastes discharged by Gowanda State Hospital and the Silver Creek Preserving Company.

OTHER TRIBUTARIES

An oil film and rust-red discoloration of two square miles out into Lake Erie is created by Bethlehem Steel as a result of its discharge to Blasdell and Smoke Creeks. A continuous oil discharge of over 30,000 pounds per day is held immediately against the shore by ice during the winter. During spring thaws the entrapped oil is liberated and joins the oils released simultaneously from the Buffalo River and other sources to cause the major oil slicks which occur on the Niagara River.

With wind from the east, the effluent from Bethlehem Steel hangs along shoreline west of Smoke Creek.

Eighteenmile Creek becomes anaerobic during low flow periods below the village of Hamburg. Moderate to heavy enrichment is apparent in upstream areas below a number of villages and in some agricultural areas.

Most other small tributaries suffer from degradation and enrichment particularly in their lower sectors. The problems from domestic wastes to these tributaries are compounded by grape processing plants and vegetable canneries which discharge high seasonal loadings to sewage plants or directly to the streams. This is particularly noticeable in Westfield, North Collins, Brocton, Fredonia, and Silver Creek. Sludge banks, slime, and low dissolved oxygen concentrations are commonplace below these outfalls. Canadaway, Slippery Rock, Walnut, Silver, and Cattaraugus Creeks are particularly affected by these cannery and grape-processing wastes. In places the waters are turned purple to black, have heavy masses of putrid sewage bacteria, and produce sickening odors.

LAKEFRONT

Unfortunately *much of the New York shoreline with its rocky base is ideally suited for the production of continual crops of attached algae which are caused by phosphorus carried to the New York shoreline by Lake Erie.* An aerial observation of the shoreline gives view to endless windrows of decomposing algae which have been washed upon the beaches. To a person wading through these masses toward the cleaner offshore waters, the slime and stench are almost unmanageable. Several water recreation areas, such as Evangola State Park, maintain beaches relatively free of these decomposing materials and dead fish only through twice daily combing the area by machine and hand. Others, such as Lake Erie State Park, Silver Creek, and Wright Park beaches have maintained very poor conditions with rotting algae commonplace.

Defilement of the area's beaches by raw sewage, septic tank effluent, sewage treatment plant effluent and bypassing and storm waters from municipal areas is common in places. These wastes are carried to the beach areas by nearshore currents and by streams such as Chautauqua, Canadaway, Silver, Cattaraugus, Big Sister, Eighteenmile, etc. While some bathing areas are affected continuously, the majority are primarily affected for one or two days directly after a summer storm. Studies by the Erie County Health Department have shown that the storm need not be severe to cause appreciable contamination by the flushing of raw or inadequately treated sewage into streams or directly to Lake Erie.

CHAPTER 4

THE CAUSE OF POLLUTION

WASTE SOURCES

Municipal waste is the principal cause of pollution in Lake Erie and its tributaries. Another major cause of pollution, especially in tributaries and harbors, is industrial wastes. These wastes consist not only of continuous, direct untreated discharges, but also combined sewer overflows and treatment plant effluents. Agricultural runoff is also a significant, but harder to define, source of pollution. Other sources of pollution are wastes from commercial and pleasure craft, spoil from harbor dredging, urban runoff, and shore erosion. All of these combined are now potentially disastrous to Lake Erie water quality.

Three geographical areas are primarily responsible for the present condition of Lake Erie (Table 4-1). These areas, in order of decreasing effect on the overall quality of Lake Erie water, are: (1) Detroit, Michigan and its surrounding municipalities, (2) the Cleveland-Cuyahoga River basin, and (3) the Maumee River basin. The Buffalo area has high waste inputs, but these wastes affect the Niagara River more than Lake Erie. Many other areas have problems which are primarily local; but cumulatively, they also have a profound effect on the general water quality.

TABLE 4-1 – Percent Waste Contribution of Major Source Areas in Lake Erie Basin

	Detroit and Southeast Michigan	Cleveland-Akron-Cuyahoga	Toledo-Maumee River
Phosphorus	40.0	18.6	15.3
Biochemical Oxygen Demand	60.3	11.0	15.5
Chloride	51.0	10.6	4.7

The remarkably degrading effect which the Detroit, Cleveland, and Maumee areas have on Lake Erie can be shown by subtracting their discharges of almost any constituent from the total input of that constituent to the lake.

MUNICIPAL WASTES

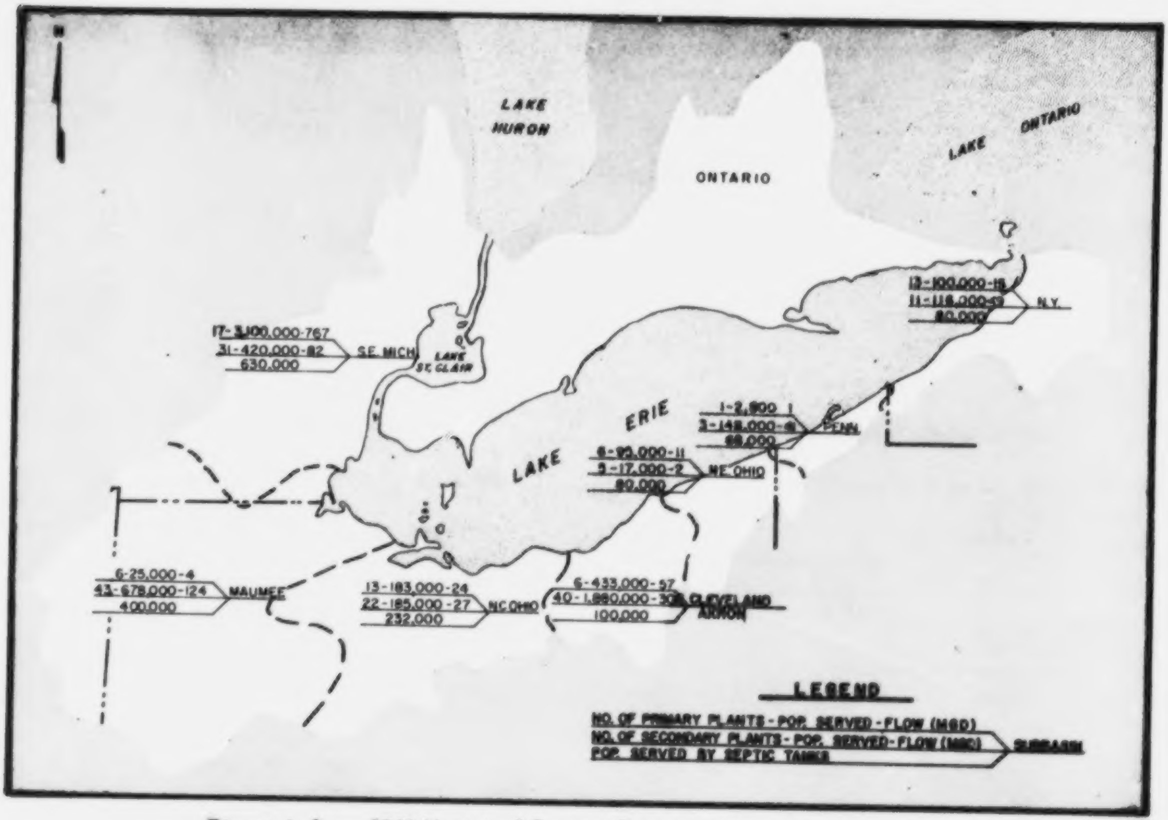
Approximately 9 million people inhabit communities within the U.S. portion of the Lake Erie basin, discharging partially treated wastes directly into Lake Erie or into its tributaries. Nearly 2 million more people are served by septic tanks. Sixty-three municipal primary treatment[1] plants serve approximately 5 million people, discharging 879 mgd of wastes; and 155 municipal secondary treatment[2] plants serve approximately 4 million people, discharging 591 mgd of wastes. Figure 4-1 shows the municipal treatment plant data by subareas. The ten largest sources of municipal waste based on strength of waste discharged are shown in Table 4-2. It is easily seen from the table that Detroit is the largest municipal polluter in the basin, and in fact contributes more wastes than all the other cities combined.

TABLE 4-2 – Ten Largest U.S. Sources of Municipal Waste in the Lake Erie Drainage Basin

Location	% of Total U.S. Municipal Waste BOD Discharged	% of Total U.S. Municipal Waste Phosphorus Load
Detroit, Michigan	64.4	46.5
Cleveland, Ohio	9.0	20.3
Toledo, Ohio	3.5	5.0
Wayne County, Michigan	3.1	2.8
Akron, Ohio	1.3	4.5
Euclid, Ohio	1.3	1.0
Lorain, Ohio	1.1	1.2
Sandusky, Ohio	1.0	0.6
Erie, Pennsylvania	0.9	2.2
Ft. Wayne, Indiana	0.5	2.6

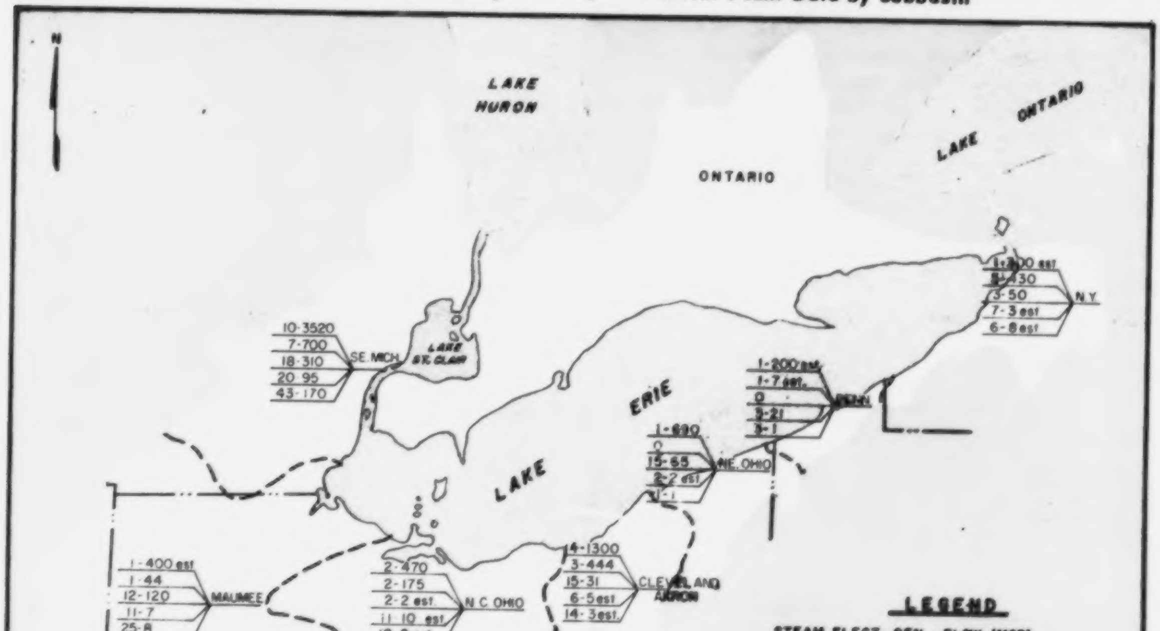
[1] A settling process which removes about 35% of organic pollutants from sewage water.

[2] A biological process which removes up to 90% of organic pollutants from sewage water.



N
LAKE HURON
ONTARIO
LAKE ONTARIO
LAKE ST. CLAIR
LAKE ERIE
17-3,100,000-767
31-420,000-82
630,000
SE. MICH.
13-100,000-15
11-118,000-13
80,000
N.Y.
1-2,800 1
3-148,000-16
68,000
PENN.
6-95,000-11
5-17,000-2
80,000
NE. OHIO
6-25,000-4
43-678,000-124
400,000
MAUMEE
13-183,000-24
22-185,000-27
232,000
NC OHIO
6-433,000-57
40-1,880,000-30
100,000
CLEVELAND AKRON
LEGEND
NO. OF PRIMARY PLANTS - POP. SERVED - FLOW (MGD)
NO. OF SECONDARY PLANTS - POP. SERVED - FLOW (MGD)
POP. SERVED BY SEPTIC TANKS
SUBBASIN

Figure 4-1 – 1960 Municipal Sewage Treatment Plant Data by Subbasin



N
LAKE HURON
ONTARIO
LAKE ONTARIO
LAKE ST. CLAIR
LAKE ERIE
10-3520
7-700
18-310
20-95
43-170
SE. MICH.
1-[illegible]00 est
[illegible]-430
3-50
7-3 est
6-8 est
N.Y.
1-200 est.
1-7 est.
0
3-21
3-1
PENN.
1-690
0
15-65
2-2 est.
1-1
NE. OHIO
1-400 est
1-44
12-120
11-7
25-8
MAUMEE
2-470
2-175
2-2 est.
11-10 est
18-8 est
N C OHIO
14-1300
3-444
15-31
6-5 est
14-3 est.
CLEVELAND AKRON
LEGEND
STEAM ELECT. GEN. - FLOW (MGD)
STEEL - FLOW (MGD)
CHEM. OIL & RUBBER - FLOW (MGD)
PAPER & FOOD - FLOW (MGD)
OTHERS - FLOW (MGD)
SUBBASIN

Figure 4-2 – 1960 Industrial Discharges by Subbasin

GPO 808-885-3

TABLE 4-3 – Municipal Treatment Plant Waste Discharges in Population Equivalents

Subarea	Before Treatment[1]	After Treatment[1]	Treatment Efficiency–%
Southeast Michigan	4,750,000	3,420,000	28
Maumee	1,100,000	240,000	78
North Central Ohio	430,000	170,000	60
Cleveland-Akron	2,400,000	630,000	74
Northeast Ohio	100,000	60,000	40
Pennsylvania	360,000	42,000	88
New York	220,000	90,000	59
Total Lake Erie basin (U.S.)	9,360,000	4,652,000	50

[1] Equivalent to the oxygen demand of raw sewage from that number of people (0.17 pounds of BOD per capita per day).

Almost the entire population of the Southeast Michigan area is in and around Detroit. The Detroit primary sewage treatment plant serves about 2.8 million people. *While 85 percent of the Southeastern Michigan population discharges wastes to sewers, the wastes from only 10 percent of the total population receive secondary treatment.* Southeast Michigan accounts for 58 percent of the entire municipal waste flow to the Lake Erie basin.

About 79 percent of the Indiana Lake Erie basin population is served by secondary sewage treatment plants, and the rest, which is basically rural, is served by septic tanks.

About 64 percent of the total population in the Ohio portion of the Lake Erie basin is served by secondary treatment. About 16 percent of the population is not served by sewer systems. The Greater Cleveland-Akron area accounts for 25 percent of the municipal waste flow to the lake.

The wastes from almost 70 percent of the population in Pennsylvania portion of the basin receive secondary treatment. The city of Erie, the largest city in Pennsylvania whose discharge reaches Lake Erie, provides secondary treatment.

In the New York area of the Lake Erie basin, the wastes from only 39 percent of the total population receive secondary treatment.

Biochemical oxygen demand (BOD) is the main municipal degradant discharged to tributary waters. The most harmful municipal contribution to the lake is in the form of nutrients – primarily nitrogen and phosphorus – although locally bacteria cause serious problems.

The total BOD discharged to municipal sewage treatment plants in the basin is equivalent to the raw sewage from a population of 9.4 million. After treatment, this is reduced to a load on the receiving waters equivalent to the raw sewage from a population of 4.7 million, or a treatment efficiency, basinwide, of 50 percent.

Municipal waste treatment plant discharges and treatment plant efficiencies summarized by subbasins are shown in Table 4-3.

INDUSTRIAL WASTES

Industrial wastes are those spent process waters associated with industrial operations which are discharged separately and not in combination with municipal wastes. Industries discharge oxygen-consuming substances equivalent to the raw sewage discharge from a population of nearly 3 million. The major industries are listed below with pollution substances common to each:

Power – Heat, Solids
Steel – COD, Acids, Iron, Solids, Phenols, Oils, Color, Heat, Toxicants
Chemical – COD, Solids, Organics, pH, Toxicants, Color
Oil – Oil, COD, Solids, Phenols
Paper – BOD, Solids, Color, Coliform
Rubber – Organics, Oil, COD, Solids
Plating, Machinery, Manufacturing – Cyanide, Chrome, Cadmium, Copper, and other heavy metals, pH, Solids
Food Processing – BOD, Oil, Solids, Color

Lake Erie and its tributaries receive industrial wastes from 360 known sources. A summary of these, by states, is given in Table 4-4, along with their treatment adequacy. *Slightly more than 50 percent of the industries are classified as having inadequate treatment facilities.*

TABLE 4-4 – Industrial Waste Source Classification

	TREATMENT	
State	Adequate	Inadequate
Ohio	119	92
Indiana	9	6
Michigan	24	68
Pennsylvania	15	5
New York	4	18
Total	171	189

Industries are responsible for 87 percent of the total waste flow discharged to Lake Erie and its tributaries. The total waste volume from industry equals 9,600 mgd with electric power production accounting for 72 'percent and steel production accounting for 19 percent of the flow. Figure 4-2 shows the industrial waste flow data by subareas.

The 20 largest industrial water users based upon volume of waste discharged exclusive of electric power production are shown in Table 4-5. It is easily seen from the table that steel, chemical, oil, and paper industries predominate in the basin. These 20 industries discharge 86 percent of the total industrial waste water if the electric power industry is excluded.

About 47 percent of the total industrial waste discharges in the basin flows directly to the lake or to lake-affected portions of the tributaries; another 44 percent is discharged to the Detroit and St. Clair Rivers.

Industries discharge millions of pounds of dissolved solids daily to Lake Erie; for example, they discharge 11 million pounds of chlorides daily and a similar quantity of sulfates. The chloride input is expected to double by 1990 unless restrictions are placed upon inputs.

TABLE 4-5 – Twenty Largest U.S. Producers of Industrial Waste Water [1] in the Lake Erie Drainage Basin

Name and Location	% of Total Industrial Waste Discharge [2]
Ford; Dearborn and Monroe, Mich.	19.7
Republic Steel; Lorain and Cleveland, Ohio and Buffalo, N.Y.	14.9
Bethlehem Steel; Lackawanna, N.Y.	13.0
Great Lakes Steel; Ecorse and River Rouge, Michigan	8.7
Jones & Laughlin Steel; Cleveland, Ohio	4.8
Wyandotte Chemical; Wyandotte, Mich.	4.1
Pennsalt Chemical; Riverview, Mich.	3.6
Gulf Oil; Toledo, Ohio	2.5
McLouth Steel; Trenton and Gibraltar, Michigan	2.4
Allied Chemical; Detroit, Michigan and Buffalo, New York	1.7
Interlake Steel; Toledo, Ohio	1.6
Scott Paper; Detroit, Michigan	1.6
Standard Oil; Toledo and Lima, Ohio	1.5
Midland Ross; Painesville, Ohio	1.1
U.S. Steel; Cleveland and Lorain, Ohio	0.9
Mobil Oil; Trenton, Michigan and Buffalo, New York	0.9
Hammermill Paper Co.; Erie, Penn.	0.7
Monsanto Chemical; Trenton, Mich.	0.7
Diamond Shamrock; Painesville, Ohio	0.6
Consolidated Paper; Monroe, Mich.	0.5

[1] Based on volume of waste water discharged.

[2] Exclusive of electric power production.

AGRICULTURAL RUNOFF

Agricultural runoff is a major source of nutrient and silt pollution to Lake Erie. The pollution results largely from surface erosion of sparsely covered, intensely cultivated, fine-grained soils. While silt covers much of the bottom of the lake and this, along with pesticides, may be influential in the fisheries problem, the nutrient input is of greater immediate concern. Increasingly larger quantities of nitrogen and phosphorus fertilizers are being applied to the land, and these substances find their way to the lake during runoff. Nutrients are also contributed in significant quantities from animal wastes.

If an estimated rate of 250 pounds of total phosphorus per square mile per year is used to calculate the agricultural contribution, almost six million pounds are contributed to Lake Erie per year from this source. The nitrogen input from runoff is at least ten times this amount.

At least eight million tons of silt are discharged to Lake Erie from agricultural runoff each year. Nearly half of this is discharged to the western basin.

The Maumee River is the greatest contributor to rural runoff pollution, in both nutrients and silt, in the Erie basin. About two million tons per year of nutrient-laden silt enter the lake from this drainage basin.

It is not likely that the rate of silt input from rural runoff will increase by any significant amount in the future because of improved soil conservation practices. In fact, it appears that the present rate is less than it has been in the past. The inputs of nutrients from rural runoff are likely to increase however, because of the rapidly increasing usage of fertilizers.

COMBINED SEWER OVERFLOWS

Combined sewer systems are recognized as very significant sources of pollutants both to tributaries and to Lake Erie. The more important materials contributed are BOD, bacteria, and the nutrients, nitrogen and phosphorus. Beaches are closed in many places because of the bacterial loadings.

Many large cities in the Lake Erie basin have combined sewer systems carrying both sewage and surface drainage water. During dry weather the sewer systems supposedly direct all flow to a sewage treatment plant. During periods of precipitation the excess flow bypasses the treatment plant and goes directly to the nearest watercourse. Many of the systems are in such poor condition that sewage is continuously bypassed; Cleveland's system is a prime example.

At present the largest contributors to Lake Erie pollution from combined sewers are the cities of Detroit, Cleveland, and Toledo. These have an immediate detrimental effect, particularly at bathing beaches in the vicinity. Combined sewers are the main reason that the entire shoreline in the Cleveland metropolitan area is unsafe for swimming.

Approximately 40 billion gallons per year flow from combined sewers directly to the basin's waterways. About half of this flow is untreated municipal waste; i.e., sewage bypassed to the overflow during rainstorms. Sewer overflows, on an annual average, contribute wastes equivalent to the oxygen demand of raw sewage from approximately 600,000 persons. *The wastes from combined sewer overflows will be much greater in the future if controls are not instituted now.* Tables 4-6 and 4-7, for example, show the projected contribution of oxygen-demanding substances from storm water overflows in 2020.

TABLE 4-6 – Projected BOD in Lbs/Day from Storm Water Overflow Assuming No Further Control Measures or Separation of Existing Sewers

Subarea	1967	2020
Southeast Michigan	43,000	90,000
Maumee	11,000	23,000
North Central Ohio	4,000	8,000
Greater Cleveland-Akron	30,000	65,000
Northeast Ohio	500	2,000
Pennsylvania	2,000	8,000
New York	12,000	25,000
Total	102,500	221,000

TABLE 4-7 – Projected BOD Lbs/Day from Storm Water Overflow* Assuming Separate Sewer Systems Throughout

Subarea	2020
Southeast Michigan	38,000
Maumee	9,000
North Central Ohio	3,000
Greater Cleveland-Akron	26,000
Northeast Ohio	2,000
Pennsylvania	2,900
New York	12,000
Total	92,900

*These tables show that the combined sewer overflow in 2020 would amount to 221,000 lbs/day BOD – more than twice the present discharge. But, if sewers are separated this discharge will amount to only 92,900 lbs/day in 2020, less than the present discharge of 102,500 lbs/day.

Sewer separation is also favored by the fact that the phosphorus contribution from combined sewers is over four times greater than that from separate sewers. Thus, in 2020, if sewers are not separated the total phosphorus load, now approximately 6,000 lbs/day, will increase to about 20,000 lbs/day. With separation, the 2020 load would be less than the present-day load.

OTHER SOURCES OF WASTES

VESSEL WASTES

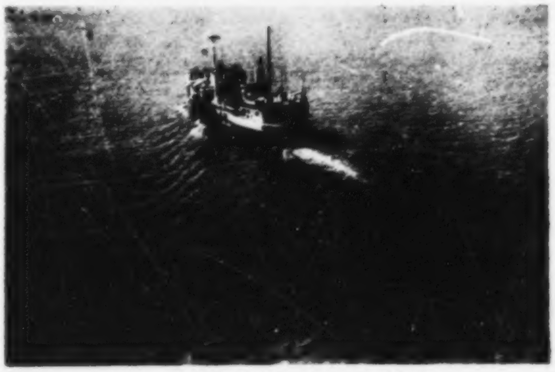
Vessel discharges are locally damaging, especially in harbor areas, although they are not a significant factor in the overall water quality of the lake. The bacterial and nutrient pollution load from commercial vessels on Lake Erie is equivalent to the raw sewage of 1,200 persons for eight months of the year or a permanent population of 800. The pollution contribution from pleasure craft is equivalent to the raw sewage of a permanent population of 5,500. Areas of particular concern from vessel wastes are around Detroit, Toledo, Sandusky, Vermilion, Rocky River, Cleveland, Ashtabula, Erie, and Buffalo.

SHORE EROSION

Erosion of the lake shore contributes an estimated 16 million tons of silt to Lake Erie per year and adds to the nutrient problem. Shore erosion is responsible for most of the nearshore turbidity of the lake during storms.

DREDGING DUMPS

All harbors along the United States shore are dredged periodically to maintain navigation channel depths. In most harbors the removed material is a combination of silt and municipal and industrial wastes, amounting to some six million cubic yards (Table 4-8) annually in the Erie basin, more than one-fourth of the total silt load to Lake Erie. Cleveland Harbor requires more dredging than any other harbor on the Great Lakes, and it contains some of the most noxious materials.



Corps of Engineers hopper dredge.

TABLE 4-8 – 1967 Estimated Harbor Dredging Spoil Dumped in Lake Erie

Harbor	Volume cu. yds.	Principal sludge source
Monroe (Raisin River)	250,000	industrial
Bolles Harbor	186,000	rural
Toledo (Maumee River)	1,000,000	rural
Sandusky	600,000	rural
Huron	180,000	rural
Lorain (Black River)	500,000	industrial, municipal, rural
Rocky River	60,000	municipal, rural
Cleveland (Cuyahoga River)	1,300,000	industrial, municipal, rural
Fairport (Grand River)	360,000	industrial, rural, municipal
Ashtabula	350,000	industrial, rural
Conneaut	400,000	rural
Erie	200,000	municipal
Dunkirk	26,000	industrial
Buffalo	620,000	industrial
Total	6,032,000	

In many cases dredging wastes harm water quality by the addition of BOD and nutrients. It has been the policy to dump the dredged materials in the lake within a few miles of the dredging sites, which may be transferring highly polluted substances to relatively unpolluted areas.

CONSTRUCTION RUNOFF – HIGHWAY AND URBAN DEVELOPMENT

Pollution from construction sites is mainly silt and is similar to agricultural runoff, but the rate per unit area is much higher. The problem is becoming increasingly serious because of the recent intensification of highway and housing programs in the Erie basin covering large areas of land. There apparently has been no adequate program of reseeding, catch-basins, etc. during construction; and the land is left barren for long periods, especially over winter.

Eroding borrow area from highway construction. (SCS Photo)

TRASH AND DEBRIS

The waterways of the Lake Erie basin are being used, in many places, for the disposal of solid wastes. Municipal and industrial dumps presently exist along the banks of most major streams. These dumps are eyesores and contribute oils, oxygen demand, trash, and other wastes.

Fallen trees and stumps choke rivers and streams at many places, blocking flow and collecting floating material. During high flows the debris is flushed downstream to harbor areas and to the lake where it interferes with commercial navigation and small boating.

OIL DISCHARGES

Most harbors and some other areas of tributaries are subjected to occasional spilling or dumping of oil, either from vessels or shore installations. Some industries, such as oil and steel companies, discharge oil intentionally and continuously. These occurrences are not only disgraceful and a direct fire hazard, but are exceedingly harmful to wildlife, waterfowl, fish, and other water supplies, and recreation. The persistence of oil, being, for the most part, nondegradable naturally, makes this problem a difficult one to overcome. The possibility of a major cargo spillage within the lake proper is real and poses a disastrous threat to the entire lake.

Methods of coping with oil pollution after a discharge, either locally or basin-wide, are not now adequate, but efforts are being made to correct this situation, especially by the Coast Guard and FWPCA.

POTENTIAL SOURCES OF POLLUTION

Offshore drilling in the lake proper for oil and gas is now being contemplated by several companies on bottom land to be leased from the states of Ohio, Pennsylvania, and New York. This is a potential source of pollution, mainly from oil spillage, brine, and drilling muds. If considerable quantities of oil are encountered in drilling, the risk of oil pollution will be of the highest degree and could lead to disaster.

Reactor plants for power sources seem to be inevitable. These represent potential sources of radioactive pollution substances. Their main contribution to the degradation of Lake Erie is and will be themal pollution because of the necessarily great amount of cooling water used.

Very important potential sources of pollution are the ultimate disposal sites of the residue from waste treatment plants. This is especially important in regard to nutrients. Nutrients removed at a treatment plant can have little effect on improving Lake Erie water quality if the nutrients still are discharged to the drainage system.

FEDERAL ACTIVITIES

In the Lake Erie basin there are 15 Federal installations that discharge directly to public waters. Of these, five are considered not to have adequate facilities:

1. The Selfridge Air Force Base in Southeast Michigan operates a secondary waste water treatment plant which discharges a chlorinated effluent into the Clinton River. There are some base facilities served by septic tanks followed by sand filters that occasionally overflow to the river without disinfection. Plans are underway to connect the base's system to the Detroit Metro System.

2. The Naval Air Station at Grosse Ile, Michigan has been responsible for significant quantities of oil in Frenchmen's Creek attributable to aircraft washings and dumps of engine oil. This can seriously interfere with wildlife and boating recreation. The Navy plans to move its air facility to Selfridge Air Force Base by July 1, 1969.

3. The Lewis Research Center (NASA) Plum Brook Facility, located near Sandusky has a complement of approximately 700. A secondary treatment plant with trickling filter and final coagulation for phosphorus removal has been constructed for treating all wastes. Tests are presently being conducted to establish maximum removal of all constituents, including phosphorus.

4. The Michigan Army Missile Plant at Warren, Michigan provides the equivalent of secondary treatment for all domestic and industrial wastes which have a combined volume of 0.8 mgd and an average BOD removal of 94%. Consideration is presently being given to connecting to the Detroit Metro System to comply with additional State requirements.

5. The Detroit Arsenal in Warren, Michigan presently discharges its municipal wastes to the Warren Sewerage System. Additional treatment is required for some industrial and coal storage drainage waters for the removal of oil and control of pH.

For these five Federal installations, adequate treatment facilities (complete secondary treatment with phosphorus removal for all domestic wastes is considered the minimum treatment necessary) should be provided by 1968. It is recognized that programs are in effect by the Air Force, Navy, and NASA to correct these inadequacies.

CONSTITUENTS IN WASTE

The waste substances that are discharged to the lake from municipal and industrial outfalls, tributaries, and land drainage are many; and their effects on water uses are varied. Many substances have severe effects on water uses in the localities of the discharges. The more important of these are acid, oil, cyanide, iron, coliform bacteria, phenol, and oxygen-consuming materials.

The most damaging substances affecting the total waters of Lake Erie are nutrients. Nutrients given the most attention are nitrogen and phosphorus, because, following carbon, they are required in the greatest amounts for the production of aquatic plants. Controlling one of these substances would control the rate of overenrichment in Lake Erie. Phosphorus is singled out in the discussion which follows because it is the one nutrient most amenable to treatment and control. *Other substances having damaging effects on the total waters of the lake are suspended solids (sediment), and carbonaceous oxygen-consuming materials.* Chlorides and dissolved solids have not reached damaging concentrations, but their dramatic increases indicate the rate at which water quality has been degraded. Summaries of the major known sources and loads of suspended and dissolved solids, chlorides, BOD, and phosphorus to Lake Erie are presented in Table 4-9.

TABLE 4-9 – Waste Loads to Lake Erie Basin Waters – 1966 (Pounds per day)

Source	BOD	Chlorides	Total Phosphorus	Suspended Solids[1]	Dissolved Solids
Industrial	480,000	10,980,000	5,900		
Municipal	900,000	1,830,000	86,400		
Rural Runoff		3,120,000	18,220		
Urban Runoff			8,760		
Lake Huron Outflow	950,000	6,500,000	<20,000	3,800,000	116,000,000
U.S. Undifferentiated				73,000,000	84,000,000
Canada Undifferentiated	100,000 est.	2,900,000	18,000	57,100,000	
Total	2,430,000	25,330,000	157,280	133,900,000	200,000,000

[1] Over two-thirds of this comes from shore erosion. Exclusive of solids (9 million tons annually) deposited in the lake in dredging operations.

SUSPENDED SOLIDS

Damage to Lake Erie from suspended matter is dependent on the nature of the material. Suspended matter from municipal discharges is primarily organic and oxygen-consuming, and its deposition results in enriched bottom muds or sludge banks. Effects of these wastes are largely local and can be corrected by proper treatment. Suspended matter from certain industries and the material from land erosion are largely inorganic and serve to fill harbors, embayments, ship channels, and the lake. Over 24 million tons of sediment washes into Lake Erie annually; two-thirds of this comes from shore erosion. Another 9 million tons annually is carried to the lake in dredging operations.

Principal sources of suspended solids discharged to Lake Erie are the Detroit, Maumee, Cuyahoga, and Grand Rivers which represent more than 40 million pounds per day. About 1.5 million pounds per day of suspended solids of the Detroit River are from industrial and municipal sources. The Maumee discharges are largely silt from land runoff. The greatest quantities are released during periods of heavy rain and high runoff; therefore, control must be instituted through improvements of land use practices in the watershed. The Cuyahoga and Grand Rivers' (Ohio) discharges are believed to be largely from land runoff and from industrial and municipal wastes. The load in the Cleveland harbor results in severe discoloration and the need for frequent dredging.

CARBONACEOUS OXYGEN-CONSUMING MATERIALS

Carbonaceous oxygen-consuming materials, usually measured by the 5-day biochemical oxygen demand (BOD), are pollutants to streams in that they depress dissolved oxygen levels. This immediate effect is not as pronounced in lakes such as Lake Erie because of its tremendous oxidation capacity. However, BOD is a measure of wastes that are used by bacteria in cell growth and reproduction, thereby creating sludge which settles to the lake bottom. Carbonaceous BOD of wastes is most effectively removed by secondary or tertiary treatment.

The present and projected daily BOD loading for the entire basin is shown in Figure 4-3 along with the loading after various degrees of reduction.

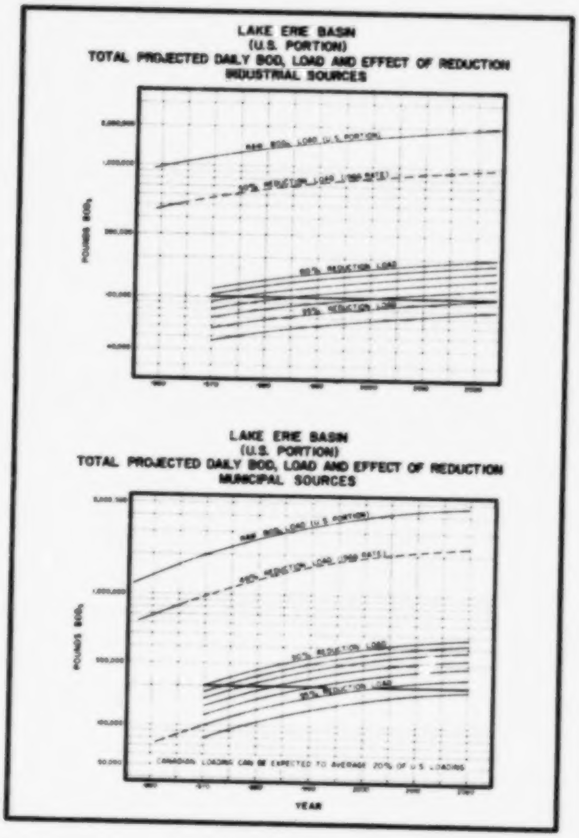


Figure 4-3 – Lake Erie Basin Total Projected Daily BOD Load and Effect of Reduction – Industrial and Municipal Sources

Figure 4-4 shows projected municipal loadings for each of the subbasins. As this figure indicates, the Detroit area contributes more BOD to Lake Erie than all other known sources combined. Table 4-10 shows present industrial and municipal BOD loads by subbasins of both the untreated waste and with treatment levels recommended in this report.

TABLE 4-10 – Present Untreated Municipal and Industrial BOD Loads by Subbasin Lbs/day

Area	Untreated BOD	With Recommended Treatment
Southeast Michigan	1,180,000	200,000
Maumee – Indiana	90,000	6,000
Maumee – Ohio	300,000	45,000
North Central Ohio	110,000	16,000
Cleveland-Akron	470,000	70,000
Northeast Ohio	30,000	5,000
Pennsylvania	220,000	34,000
New York	140,000	24,000
Total	2,540,000	400,000

CHLORIDES

Lake Huron discharges 6.5 million pounds of chlorides per day, accounting for [illegible] percent of the total chloride load to Lake Erie. The Detroit-Windsor area discharges 9.5 million pounds per day or 38 percent. Thus, *nearly two-thirds of the chloride load to Lake Erie enters at the mouth of the Detroit River.* The Grand River (Ohio) contributes another 3.9 million pounds, or 15 percent; and the Cuyahoga and Maumee Rivers contribute 1.5 million pounds per day or about 6 percent of the total to Lake Erie.

Table 4-9 lists the known chloride loads to Lake Erie from various kinds of contributors. In addition to the Lake Huron input, contributing 26 percent, industry accounts for 43 percent, municipal wastes 7 percent, and street deicing (runoff) 12 percent. The remaining 12 percent is derived from undifferentiated Canadian sources.

Figure 4-5 shows the projected chloride loadings by subbasin, and Figure 4-6 shows projected total lake loading and the effects of various degrees of reduction.

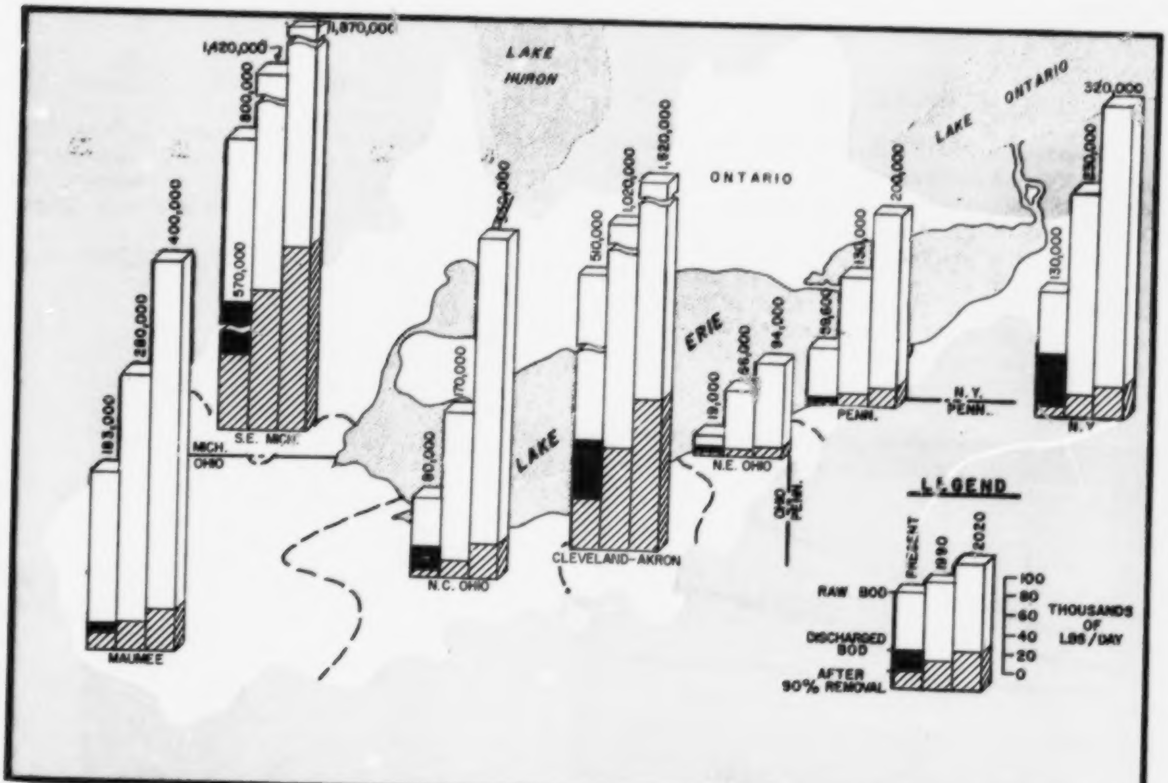
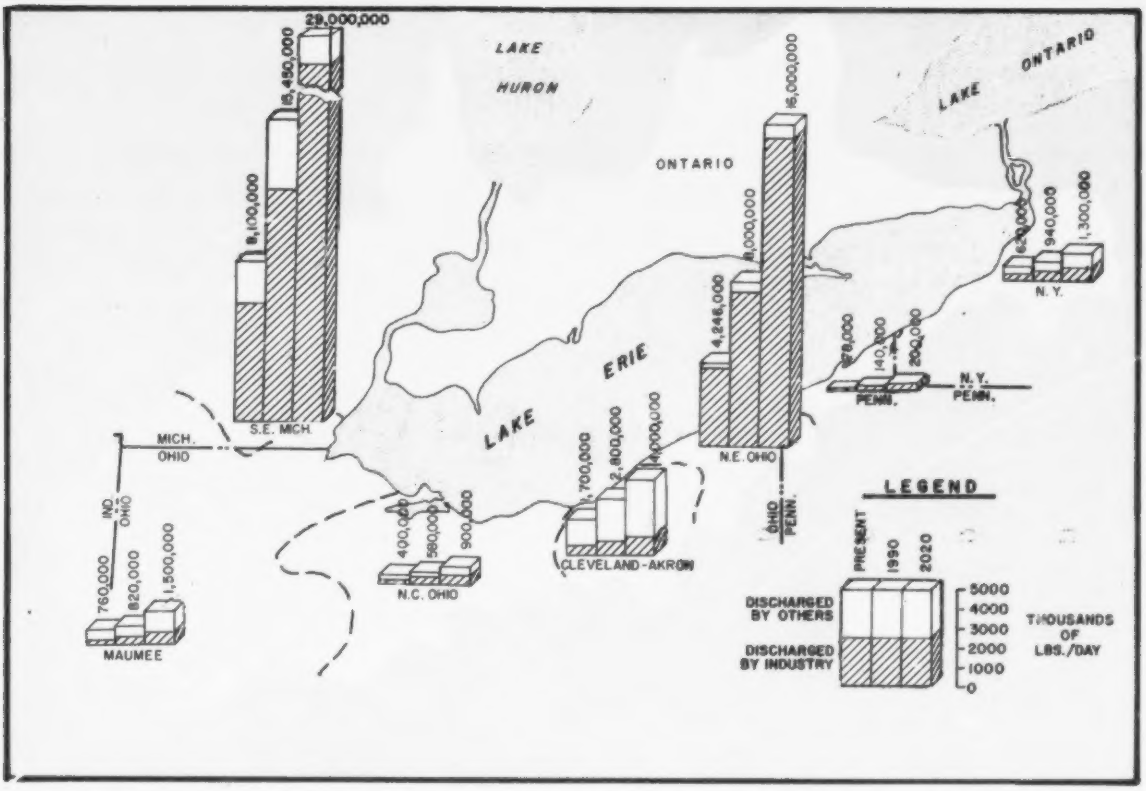


Figure 4-4 – Present and Projected BOD Load Discharged in the Lake Erie Basin



29,000,000
16,450,000
9,100,000
S.E. MICH.
LAKE
HURON
ONTARIO
LAKE ONTARIO
16,000,000
8,000,000
4,246,000
N.E. OHIO
620,000
940,000
1,300,000
N.Y.
76,000
140,000
200,000
PENN.
N.Y.
PENN.
LAKE ERIE
1,700,000
2,800,000
4,000,000
CLEVELAND-AKRON
OHIO
PENN.
400,000
580,000
900,000
N.C. OHIO
MICH.
OHIO
IND.
OHIO
760,000
820,000
1,500,000
MAUMEE
LEGEND
PRESENT
1990
2020
DISCHARGED BY OTHERS
DISCHARGED BY INDUSTRY
5000
4000
3000
2000
1000
0
THOUSANDS OF LBS./DAY

Figure 4-5 – Present and Projected Chloride Discharges in the Lake Erie Basin Without Additional Controls

DISSOLVED SOLIDS

Dissolved solids concentrations at the head of the St. Clair River average 110 mg/1, at the head of the Detroit River 126 mg/1, and Lake Erie at Buffalo 180 mg/1. These levels represent daily inputs of 116 million pounds per day from the watershed above Detroit and a discharge of almost 200 million pounds per day to the Niagara River from Lake Erie. *Most of the increase within Lake Erie actually is derived from the Detroit area.*

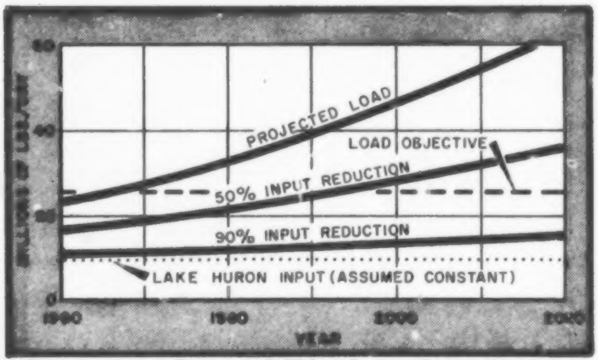


Figure 4-6 – Projected Chloride Load to Lake Erie and Loads with Various In-Basin Load Reductions

PHOSPHORUS

The principal in-basin sources of phosphorus are municipal wastes (72 percent), agricultural runoff (17 percent), urban runoff (7 percent), and industrial wastes (4 percent), Table 4-11. These

Dead algae along shore of Kelleys Island.

TABLE 4-11 – Present and Projected Phosphorus Discharges to Lake Erie Exclusive of Lake Huron Input – lbs/day

Subbasins	Municipal Waste	Industrial Waste	Urban Runoff	Rural Runoff	Total
Present Loading					
Southeast Michigan	46,000	3,000	3,000	3,000	55,000
Maumee River Basin	9,000	1,000	1,000	10,000	21,000
North Central Ohio	3,800	500	1,600	2,600	8,500
Greater Cleveland-Akron area	22,000	800	2,000	700	25,500
Northeast Ohio	1,100	100	500	750	2,450
Pennsylvania	1,400	100	110	220	1,830
Western New York	3,000	500	650	1,000	5,150
Ontario	11,900	unknown	450	5,500	17,850
	98,200	6,000	9,310	23,770	137,280
Projected 1990 Loading					
Southeast Michigan	85,000	4,500	4,500	3,000	97,000
Maumee River Basin	12,000	1,500	2,000	10,000	25,500
North Central Ohio	8,000	750	2,400	2,600	13,750
Greater Cleveland-Akron area	40,000	1,200	3,000	700	44,900
Northeast Ohio	3,700	200	700	700	5,300
Pennsylvania	3,100	180	160	210	3,650
Western New York	6,100	750	1,000	1,000	8,850
Ontario	21,400	– –	810	6,500	28,710
	179,300	9,080	14,570	24,710	227,660

inputs total 137 thousand pounds per day and exclude the Lake Huron input of somewhat less than 20 thousand pounds per day. In municipal wastes about one pound per capita per year is contributed by human excreta and 2.5 pounds per capita per year by detergents. Phosphorus from agricultural runoff amounts to about 250 pounds per square mile per year. Urban runoff contributes phosphorus at the rate of about 530 pounds per square mile per year.

Figure 4-7 shows the contributions of phosphorus for each of the subbasins and the projected contributions for the years 1990 and 2020. *Phosphorus loadings to Lake Erie will increase nearly 2.5 times by 2020 if the present rates continue unchecked.* Figure 4-8 shows total projected phosphorus inputs from various sources.

The Detroit area contributes by far the largest amount (40 percent) of phosphorus to Lake Erie, more than twice as much as either the Cleveland or the Maumee areas, the next two major sources.

RADIOACTIVE SUBSTANCES

The content in Lake Erie of radioactive wastes is increasing, primarily from atmospheric fallout, nuclear power plants, and from medical uses. Limits for discharge are set by the Atomic Energy Commission. The levels in Lake Erie and in tributaries are low and are not known to be harmful, but the substances are cumulative and lost only by long natural decay. Increasing conversion of the energy for electric power production from fossil to nuclear fuels indicates that radioactive waste levels will continue to rise.

TOXIC SUBSTANCES

Many substances toxic to aquatic life and even to human life are discharged to the waters of the Lake Erie basin. Fortunately all are either degraded or diluted to acceptable levels quickly upon reaching the lake proper.

Toxic metals such as copper, cadmium, chromium, lead, nickel, zinc, and iron are discharged in significant quantities by primary metals and metal-fabricating industries. Areas of concern are near the mouths of the Rouge, Black, Cuyahoga, and Buffalo Rivers.

Some toxic metals, such as copper, may be accumulated and stored by algae and cause difficulties in the life forms which consume these organisms.

Many organic chemicals are toxic, or near toxic, such as the multitude of insecticides, and the organic compounds discharged by the plastics industries. Phenols are waste products of the iron and oil industries. The Detroit-Maumee basin, Lorain, Cleveland-Akron, and Buffalo areas, produce large quantities of organic chemical wastes.

ACIDS

Acids, products of many industries, are indirectly toxic in that they may reduce the pH of the receiving waters to levels interfering with fish and aquatic life. Detroit, Cleveland, and Buffalo are areas of large acid discharges.

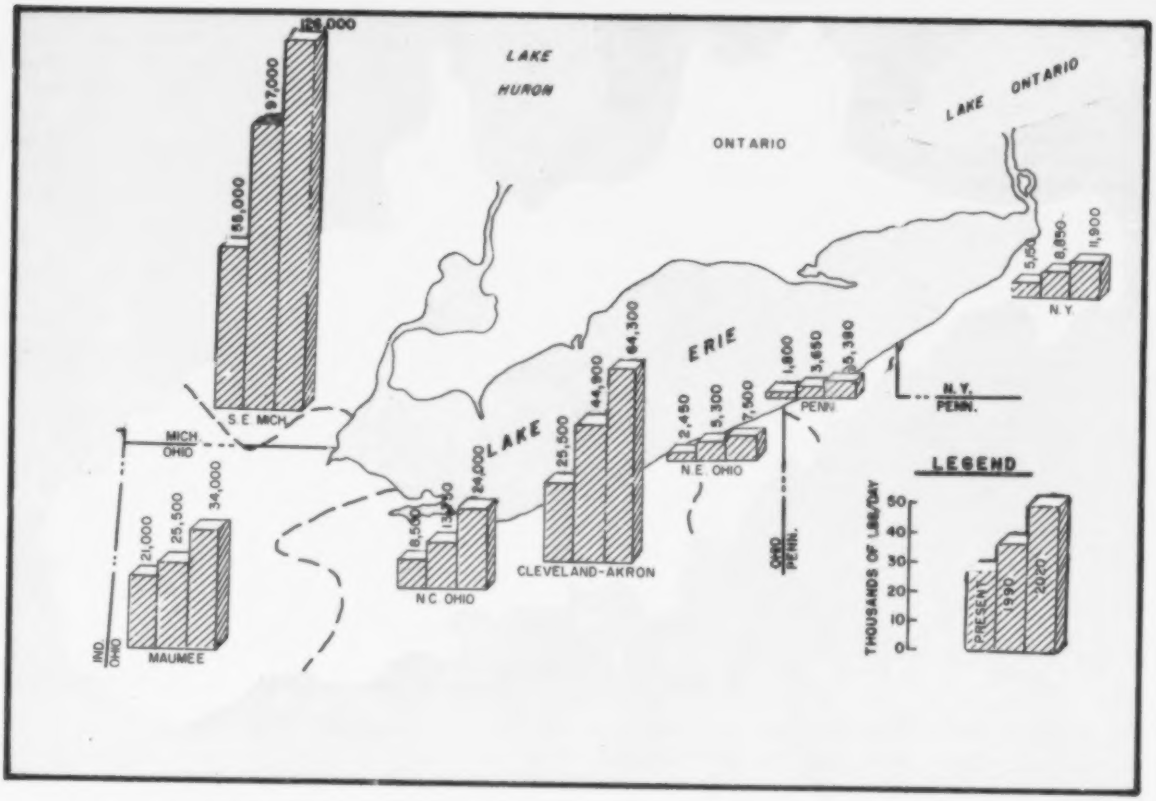

126,000
97,000
58,000
S.E. MICH
LAKE
HURON
ONTARIO
LAKE ONTARIO
MICH
OHIO
21,000
25,500
34,000
IND
OHIO
MAUMEE
8,500
24,000
N.C. OHIO
LAKE
25,500
44,900
64,300
CLEVELAND-AKRON
ERIE
2,450
5,300
7,500
N.E. OHIO
1,800
3,650
5,380
PENN.
OHIO
PENN.
N.Y.
PENN.
8,850
11,900
N.Y.
LEGEND
THOUSANDS OF LBS/DAY
50
40
30
20
10
0
PRESENT
1990
2020

Figure 4-7 – Present and Projected Phosphorus Discharges in the Lake Erie Basin Without Additional Controls

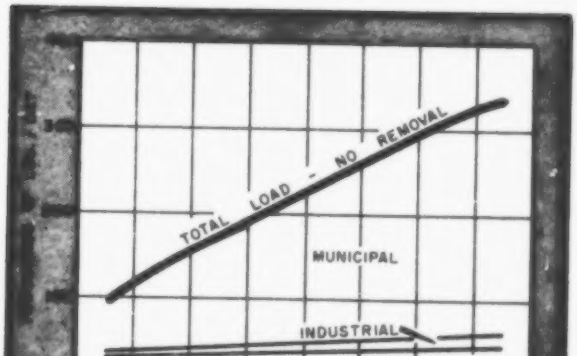


Figure 4-8 – Projected Phosphorus Load to Lake Erie by Source-Cumulative

OIL

Oil is persistent and difficult to decompose in water and has serious effects on all forms of water uses. Large quantities are discharged continuously by the steel and oil industries in Detroit, Toledo, Cleveland, and Buffalo. Oil is also contained in municipal wastes in significant quantities.

Oil, as a heavy floating scum, is continuously present in many harbor areas, particularly in the Rouge at Detroit, the Cuyahoga at Cleveland, and in the Buffalo River.

HEAT

Heat or thermal pollution is a waste product of many industries. It is significant in electric power production. The increase in temperature may be 20°F or more with one pass through a power plant. This would be significant in small bodies of water where the water is recycled. It can affect temperature-sensitive organisms in the lake in the immediate vicinity of the discharges, but it does not cause a measurable temperature increase in the lake as a whole. It is possible, though not likely, that increased power production from nuclear energy will cause a measurable increase.

Steel industries also cause local rises in temperature with cooling water and slag discharges. This source of heat is not likely to increase significantly except locally in tributaries. It is in tributaries that temperature problems are now of concern.

Detroit Edison steam electric generating plant.

CHAPTER 5

WATER POLLUTION CONTROL NEEDS

This chapter discusses immediate and long-range needs for pollution abatement and control. Needed current actions are based primarily on the requirements to meet the interstate water quality standards established by the basin states, similar requirements on intrastate waters, and the requirements of the Lake Erie enforcement conferences. Needed actions are summarized in Table 5-1.

The remedy for the problems of Lake Erie must begin with the recognition that an effective pollution abatement program or plan must involve action and cooperation at every level of government – local, state, and federal.

The tools are available for doing the job. The basic legislation, the technical competence, and equipment, are now at hand.

The first and second steps to save the lake have been reached. First the five states have agreed to a set of requirements established by the enforcement conferences on Lake Erie; and second, the five states have submitted interstate water quality standards to the Secretary of the Interior which set forth goals and ways to reach them.

Now the work agreed to in the enforcement conferences and water quality standards implementation plans must be carried out.

ENFORCEMENT

In 1961 the Governor of Michigan requested a State-Federal intrastate enforcement conference on the Michigan waters of the Lake Erie basin. At this conference, binding pollution abatement agreements and remedial schedules were established for 11 units of municipal government and 25 industries in Michigan.

In 1965 the Governor of Ohio requested an interstate enforcement conference for all of Lake Erie. At this conference, a set of requirements was established and agreed upon by each of the states. The requirements are contained in the conclusions of that conference as follows:

TABLE 5-1 – Summary of Water Pollution Control Needs

Category	Need	Responsibility
Implementation of water quality standards and enforcement conference requirements	Sewer construction, Secondary treatment, Tertiary treatment, Phosphorus control, Equivalent industrial waste treatment	Municipalities, Industries, States, and FWPCA
Intrastate Control Institutions	Area-wide development plans, Regional authorites, Intrastate water quality standards	States and Metropolitan areas
Surveillance	Development of data base in areas of greatest water pollution control needs	States, FWPCA, USGS

TABLE 5-1 – Summary of Water Pollution Control Needs (continued)

Category	Need	Responsibility
Evaluation	Review progress of municipalities and industries in abating pollution	States
Dredging Control	Develop and implement alternatives to lake disposal of dredged materials	U.S. Corps of Engineers, FWPCA
Oil and Gas Well Drilling	Prevent any wastes from these operations from getting into waters of the basin	States and drilling industries
Research and Development	Research into – 1. Methods of tertiary treatment 2. Phosphorus control 3. Sludge disposal 4. Cause of fish mortalities 5. Role of bottom sediments in lake pollution 6. Ways to prevent formation of oxygen deficient zones in lake 7. Control of soil runoff 8. Eutrophication studies	Federal Government States, Industries, Universities, Local Government
Erosion Control	Reduce urban and agricultural soil erosion	Soil Conservation Service, Bureau of Public Roads, U.S. Corps of Engineers, Other Federal, state, and local construction agencies
Training	Better and more training for all phases of water pollution control including treatment plant operation	State, Federal Government, Industry, Institutions, Local Government
Strengthen State Pollution Control Program	Increased 1. Enforcement 2. Training 3. Technical assistance 4. Research 5. Direction 6. Supervision of treatment performance 7. Planning for water quality management	Governors and State legislatures increase manpower and financing of state pollution control programs
Financial	Increased financial aid for areas needing pollution abatement facilities	Federal Government, States, Local Government, Industry
Coordination with Canada	Pollution abatement for entire lake	States, Federal Government, IJC, Canada
A Look Ahead	New authorities and water quality management institutions for organized and efficient pollution control	States Federal Government

REVISED CONCLUSIONS AND RECOMMENDATIONS OF THE CONFEREES – AUGUST 12, 1965*

1. The waters of Lake Erie within the United States are interstate waters within the meaning of section 8 of the Federal Water Pollution Control Act. The waters of Lake Erie and its tributaries within the United States are navigable waters within the meaning of section 8 of the Federal Water Pollution Control Act.

2. Lake Erie and many of its tributaries are polluted. The main body of the lake has deteriorated in quality at a rate many times greater than its normal aging processes, due to the inputs of wastes resulting from the activities of man.

3. Identified pollutants contributing to damages to water uses in Lake Erie are sewage and industrial wastes, oils, silts, sediment, floating solids and nutrients (phosphates and nitrates). Enrichment of Lake Erie, caused by man-made contributions of nutrient materials, is proceeding at an alarming rate. Pollution in Lake Erie and many of its tributaries causes significant damage to recreation, commercial fishing, sport fishing, navigation, water supply, and esthetic values.

4. Eutrophication or over-fertilization of Lake Erie is of major concern. Problems are occurring along the lake shoreline at some water intakes and throughout the lake from algal growths stimulated by nutrients. Reduction of one or more of such nutrients will be beneficial in controlling algal growths and eutrophication.

5. Many sources of waste discharge reaching Lake Erie have inadequate waste treatment facilities. The delays in controlling this pollution are caused by the lack of such adequate facilities and the complex municipal, industrial, and biological nature of the problem.

6. Interstate pollution of Lake Erie exists. Discharges into Lake Erie and its tributaries from various sources are endangering the health or welfare of persons in states other than those in which such discharges originate. In large measure this pollution is caused by nutrients which over-fertilize the lake. This pollution is subject to abatement under the Federal Water Pollution Control Act.

7. Municipal wastes are to be given secondary treatment or treatment of such nature as to effectuate the maximum reduction of BOD and phosphates as well as other deleterious substances.

8. Secondary treatment plants are to be so designed and operated as to maximize the removal of phosphates.

9. Disinfection of municipal waste effluents is to be practiced in a manner that will maintain coliform densities not in excess of 5,000 organisms per 100 ml. at water supply intakes, and not in excess of 1,000 organisms per 100 ml. where and when the receiving waters in proximity to the discharge point are used for recreational purposes involving bodily contact. It is recognized that bathing water quality standards are established by statute in New York State.

10. All new sewerage facilities are to be designed to prevent the necessity of bypassing untreated waters.

11. Combined storm and sanitary sewers are to be prohibited in all newly developed urban areas, and eliminated in existing areas wherever feasible. Existing combined systems are to be patrolled and flow-regulating structures adjusted to convey the maximum practicable amount of combined flows to and through treatment plants.

12. Programs are to be developed to prevent accidental spills of waste materials to Lake Erie and its tributaries. In-plant surveys with the purpose of preventing accidents are recommended.

13. Unusual increases in waste output and accidental spills are to be reported immediately to the appropriate State agency.

14. Disposal of garbage, trash, and other deleterious refuse in Lake Erie or its tributaries is to be prohibited and existing dumps along river banks and shores of the lake are to be removed.

15. The conferees are to meet with representatives of Federal, State, and local officials responsible for agricultural, highway, and community development programs for the purpose of supporting satisfactory programs for the control of runoff which deleteriously affects water quality in Lake Erie.

16. Industrial plants are to improve practices for the segregation and treatment of waste to effect the maximum reductions of the following:

a. Acids and alkalies
b. Oil and tarry substances
c. Phenolic compounds and organic chemicals that contribute to taste and odor problems
d. Ammonia and other nitrogenous compounds
e. Phosphorus compounds
f. Suspended material
g. Toxic and highly-colored wastes

---

*Representative of: Indiana, Michigan, New York, Ohio, Pennsylvania, and U. S. Department of Health, Education and Welfare.

h. Oxygen-demanding substances
i. Excessive heat
j. Foam-producing discharges
k. Other wastes which detract from recreational uses, esthetic enjoyment, or other beneficial uses of the waters.

17. The Michigan, Indiana, Ohio, Pennsylvania, and New York water pollution control agencies are to undertake action to insure that industrial plants discharging wastes into the waters of Lake Erie and its tributaries within their respective jurisdictions institute programs of sampling their effluents to provide necessary information about waste outputs. Such sampling shall be conducted at such locations and with such frequency as to yield statistically reliable values of all waste outputs and to show their variations. Analyses to be so reported are to include, where applicable: pH, oil, tarry residues, phenolics, ammonia, total nitrogen, cyanide, toxic materials, total biochemical oxygen demand, and all other substances listed in the preceding paragraph.

18. Waste results are to be reported in terms of both concentrations and load rates. Such information will be maintained in open files by the State agencies for all those having a legitimate interest in the information.

19. The U.S. Department of Health, Education, and Welfare is to establish water pollution surveillance stations at appropriate locations on Lake Erie. Surveillance of the tributaries will be the primary responsibility of the States. The Department of Health, Education and Welfare will assist the States at such times as requested.

20. The U.S. Department of Health, Education, and Welfare will be responsible for developing up-to-date information and experience concerning effective phosphate removal and the control of combined sewer systems. This information will be reported to the conferees regularly.

21. Regional planning is often the most logical and economical approach toward meeting pollution problems. The water pollution control agencies of Michigan, Indiana, Ohio, Pennsylvania, and New York, and the Department of Health, Education, and Welfare will encourage such regional planning activities.

22. Within six months after the issuance of this Summary, the State water pollution control agencies concerned are to present a schedule of remedial action to the Conferees for their consideration and evaluation.

23. The Federal Conferee recommends the following for the consideration of the State agencies:

a. Recommended municipal treatment: Completion of plans and specifications, August, 1966; completion of financing, February, 1967; construction started, August, 1967; construction completed, January 1, 1969; chlorination of effluents, May 15, 1966; provision of stand-by and emergency equipment to prevent interruptions in operation of municipal treatment plants, August, 1966; patrolling of combined sewer systems, immediately.
b. Discontinuance of garbage and trash dumping into waters: Immediately.
c. Industrial waste treatment facilities: Completed and in operation by January 1, 1969.

24. Federal installations: Waste treatment facilities are to be completed and in operation by August of 1966.

25. Representatives of the U.S. Army Corps of Engineers are to meet with the Conferees, develop and put into action a program for disposal of dredged material in Lake Erie and its tributaries which will satisfactorily protect water quality. Such a program is to be developed within six months after the issuance of this Summary and effectuated as soon as possible thereafter.

26. The conferees will establish a Technical Committee as soon as possible which will evaluate water quality problems in Lake Erie relating to nutrients and make recommendations to the conferees within six months after the issuance of this Summary.

27. The conference may be reconvened on the call of the Chairman.

At the conclusion of the Cleveland session of the conference, the following was included among the conclusions and recommendations of the conference:

"Pollution of navigable waters subject to abatement under the Federal Water Pollution Control Act is occurring in the Ohio waters of Lake Erie and its tributaries. The discharges causing and contributing to the pollution come from various municipal and industrial sources, from garbage, debris, and land runoff.

"Pollution of the Ohio waters of Lake Erie and its tributaries within the State of Ohio endangers health and welfare."

Binding pollution abatement agreements and remedial schedules were established for 118 units of municipal government and 146 industries for compliance by 1971. All municipal schedules called for a minimum of secondary treatment and disinfection and in Michigan an additional binding requirement for 80 percent phosphate removal was included.

The Lake Erie enforcement conferees also established a technical committee to delve into the nutrient problem in Lake Erie. From this committee

came a set of recommendations, summarized below, which were agreed to by each of the states.

1. Establishment of nutrient water quality objectives for Lake Erie.

2. Promotion and encouragement of accelerated research and development of a suitable product solution to the detergent-phosphate problem.

3. Control of phosphates in sewage treatment.

4. Standardization of analytical techniques.

5. Research into factors affecting the Lake Erie fishery, municipal water supplies, and recreational uses.

WATER QUALITY STANDARDS

Passage in 1965 of the water quality standards provisions of the Federal Water Pollution Control Act created an effective new force for the control of water pollution. The standards, once established, bring into focus the actions needed both to abate existing pollution and to prevent further pollution.

The plans to implement the water quality standards are of primary significance, since they describe what must be done, by whom, and by what date to meet the quality criteria. These plans are based on present and anticipated uses of the waters, and on criteria associated with such uses. A major consideration in developing and evaluating the standards is the realistic proposition that *what is needed is not the highest possible standard but the highest standard possible* at this time. Without exception, this characterizes the standards proposed by the five states in the Lake Erie basin.

The implementation plans cover many areas which are basic to any pollution abatement program, whether of a long-range blueprint type or a shorter-range plan for correcting current needs. Some of the elements incorporated in these plans, and to which the States as a consequence of the standards-setting process are committed, include:

1. *The identification of significant sources* of municipal and industrial waste water and an estimate of the general level of treatment now practiced by the principal treatment facilities.

2. *A time schedule for completion of remedial facilities* which will provide for the abatement of substantial existing conventional municipal and industrial pollution by mid-1972. In some cases, the time schedule is provided against which compliance can be measured.

3. *The establishment of secondary waste treatment* as a minimum treatment level for all significant municipal wastes, and equivalent treatment as the minimum for industrial wastes.

4. *Recognition of the need, before 1977, for treatment greater than secondary* at specific installations. Also provided is an expression of intent on the part of the State agencies to require nutrient removal to the greatest extent possible, consistent with available technology.

5. *The establishment of more satisfactory bacteriological quality* for body contact sports – so that this water use within the basin can expand consistent with long-range goals.

6. *General recognition and acceptance of the recommendations of the Detroit River and Lake Erie enforcement conferences along with the results of the evaluation by the latter's technical committee on nutrients and their effects. This evaluation provides the baseline for determining the total allowable loading of phosphorus to the lake itself, a level toward which all efforts must be directed.*

In some cases, the water quality standards proposed by the States include requirements in addition to the above, or include other expressions of intent. As an example, the standards proposed by the Ohio Water Pollution Control Board recognize and support the elements of the Northwest Ohio Water Development Plan developed by the Ohio Water Commission. This Ohio plan recognizes, among other requirements, the need within the next decade for establishing sewer systems and advanced waste treatment systems in most of the municipalities in northwest Ohio.

For intrastate waters in the basin, water quality standards are not a direct requirement under the Federal Water Pollution Control Act. The Act, however, does contain provisions which make it advantageous to the States to also promulgate standards for these waters. All of the Lake Erie States recognize these advantages – i.e., the resulting larger contributions of Federal construction grant funds – and are in the process of establishing enforceable standards for intrastate streams.

New York has had a system of standards for all of its waters and is now pledged to a continuing program of upgrading and improving the classification system and associated criteria.

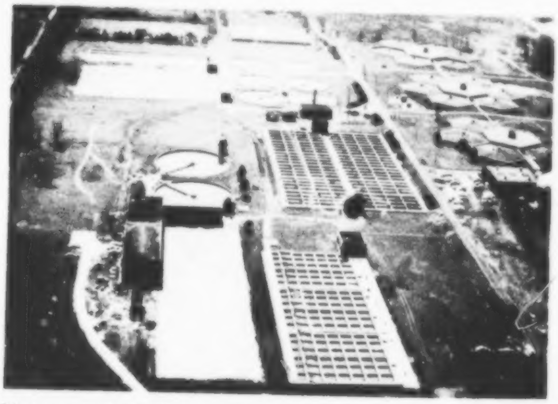
Pennsylvania in 1944 adopted a classification system for all of its streams. These have been subjected to periodic review and upgrading, where necessary. The State has indicated that this updating will continue, with priority on updating streams which at present are adversely affected by pollution.

Michigan has adopted intrastate standards which are similar to the interstate standards and is now in the process of establishing water uses for the streams.

MUNICIPAL AND INDUSTRIAL WASTE TREATMENT NEEDS

To catch up with the backlog of needed sewage treatment plants 287 municipalities need to upgrade treatment. To cope with the expected population growth, many new, enlarged and consolidated treatment schemes must be devised. *The Lake Erie basin should be served now by treatment resulting in a minimum of 85 percent removal of BOD, substantially complete removal of suspended solids, and 92 percent removal of total phosphorus.* By 1990 tertiary treatment [1] should be a general basin-wide requirement.

One hundred eighty-nine industries in the Lake Erie basin need to install treatment facilities to meet water quality standards, the requirements of the enforcement conferences, and the needs of this report.



Many municipal treatment plants presently provide treatment for industrial process wastes.

Wherever feasible, *industries are encouraged to connect to municipal plants* after they have provided suitable pretreatment of waste. In this way, overall waste treatment can be improved and financial gains will result because the city could qualify for an increased federal construction grant.

Perhaps *the best way to control industrial discharges is by inplant process changes to prevent or lessen the original waste products.* Industrial incentives are needed to encourage this type of abatement.

The industries that discharge significant waste products into the Lake Erie basin are the heavy chemical, steel, paper, and oil industries. *Uniform industrial pollution control objectives should be established by each of the basin states for industries discharging directly to the lake or to lake-affected backwaters.* Unlike a flowing stream, it is impossible to establish direct cause and effect relationships for each waste effluent though the cumulative effect on the lake is obvious. The lake and its backwaters should thus be considered as mixing, but non-flowing, bodies of water with additive causes and effects throughout.

Furthermore, *uniform control requirements will provide a nondiscriminatory and sound basis for the design of waste treatment facilities* by each industry.

The effluent objectives in industrial waste control should be explicitly defined for each pollutant and at least equivalent to the reductions achieved for municipal wastes in a secondary treatment plant. Discharges of suspended solids, oils, oxygen-consuming substances, iron, toxic substances, acids, taste and odor producing substances, and other deleterious materials should be reduced to the lowest practicable levels.

It is therefore proposed that the Lake Erie basin states establish uniform effluent objectives applicable to each industrial waste outfall discharging directly to the lake or lake-affected backwaters.

Dissolved solids are not covered in the preceding proposal because information is limited on practical methods to control them. Their concentrations are increasing in Lake Erie, however, and unless something is done to halt their increase, the levels will continue to rise as cities and industries expand. With this in mind, *industries should be required to maintain the flow of dissolved solids from their factories at the present level of discharge,* or to decrease this discharge where practical.

The balance of this subsection will be devoted to a discussion of the municipal and industrial waste treatment needs for various subareas around the Lake Erie basin. Waste treatment needs for each city and industry are tabulated in the Appendix.

SOUTHEAST MICHIGAN

Southeast Michigan, whose wastes affect the entire lake, must bear the major share of the responsibility for the pollution of Lake Erie. Almost two-thirds of the total municipal waste load and nearly half of the total industrial waste load to Lake Erie originate in southeast Michigan. Elimination of both industrial and municipal wastes is of the utmost importance to the lake's preservation.

---

[1] A process which removes in excess of 95 percent of the organic pollutants from sewage water.

As a result of the state-federal enforcement conference in Michigan in 1965, the City of Detroit and other units of municipal government and industry along the Detroit River and Lake Erie shoreline have agreed to abatement orders and many have begun construction of remedial facilities.

Attainment of good water quality in southeast Michigan is dependent on the development and implementation of a comprehensive plan for the entire area. Such a plan, characterized by interceptor drainage systems, has been recommended by the National Sanitation Foundation (NSF) and is depicted in Figure 5-1. This master plan, calls for:

1. *Intercepting the wastes originating primarily along the St. Clair River and in the Counties of St. Clair, Sanilac, and Lapeer,* with waste treatment being provided near the City of Algonac on the St. Clair River. This portion of the interceptor system would be needed by the year 2000.

2. *Expansion of the present service area of Detroit* to intercept the wastes originating in Macomb and Oakland Counties and draining to the Clinton River and Lake St. Clair, with secondary treatment at the site of the now-existing Detroit sewage treatment plant. This portion of the interceptor system is an immediate need.

   Already this portion of the plan is being implemented to carry wastes from the large communities in the Clinton River basin, as well as Selfridge Air Force Base, through an interceptor system to the City of Detroit for treatment. This action resulted from a sewer construction ban imposed by the Michigan Department of Public Health, in which they declared that further development of the area would not be approved until a satisfactory waste treatment system was established. Major cities and townships having treatment facilities in Macomb County have agreed to connect to the Detroit Water Board regional interceptors. Two remaining cities, Warren and Mt. Clemens,[1] should also connect to this system, but as of this date have not agreed to do so because of the many millions of dollars they have presently invested in treatment facilities for which bonding commitments have not as yet been satisfied.

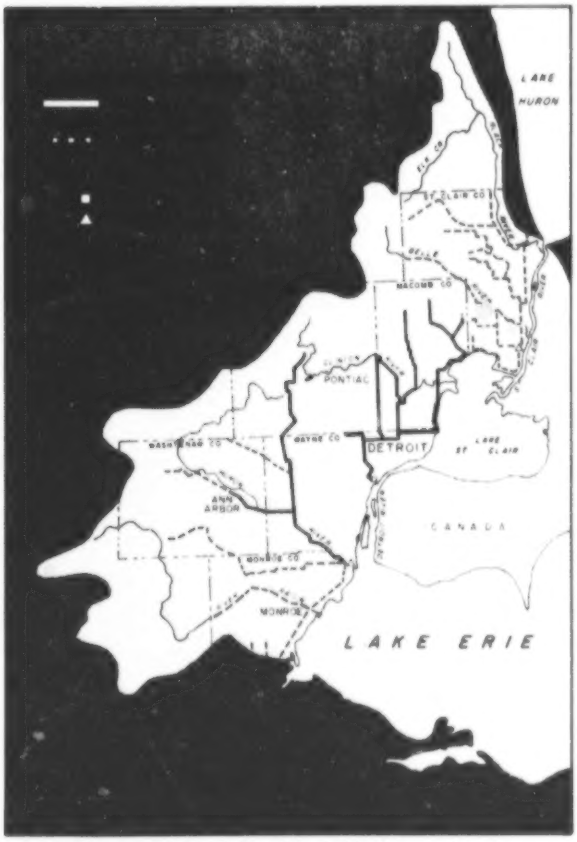


Figure 5-1 – Southeast Michigan Area Proposed Interceptors

3. *Interception of waste drainage of the Huron River and much of the Raisin River and Monroe County drainage,* including the western shoreline of Lake Erie down to the Ohio border and the city of Monroe, with centralized treatment on Lake Erie at the mouth of the Huron River. One change suggested by the FWPCA is to construct two regional plants, one to serve the Huron River, and one to serve the Raisin River. The Huron River portion of the interceptor proposal would be needed by the 1980's, the Raisin River portion by the year 2000.

The proposal of the NSF with modifications by FWPCA represents the long-range master plan for pollution control in southeast Michigan. For immediate pollution control, the needs are summarized in Table A-1 on page 87. The estimated cost of the immediate needs is $650 million, more than two-thirds of which is for sewer construction. Figure 5-2 illustrates the short and long term pollution control requirements.

A watershed management system must exist to implement this overall program. Such an organization does exist in southeast Michigan in the newly named Southeastern Michigan Council of Governments – A Regional Planning Commission. This group has adopted the above plan and is the agency given primary responsibility for its implementation.

---

[1] Mt. Clemens and Warren have been given a choice by the Michigan Water Resources Commission of connecting to the metro system or providing advanced waste treatment.

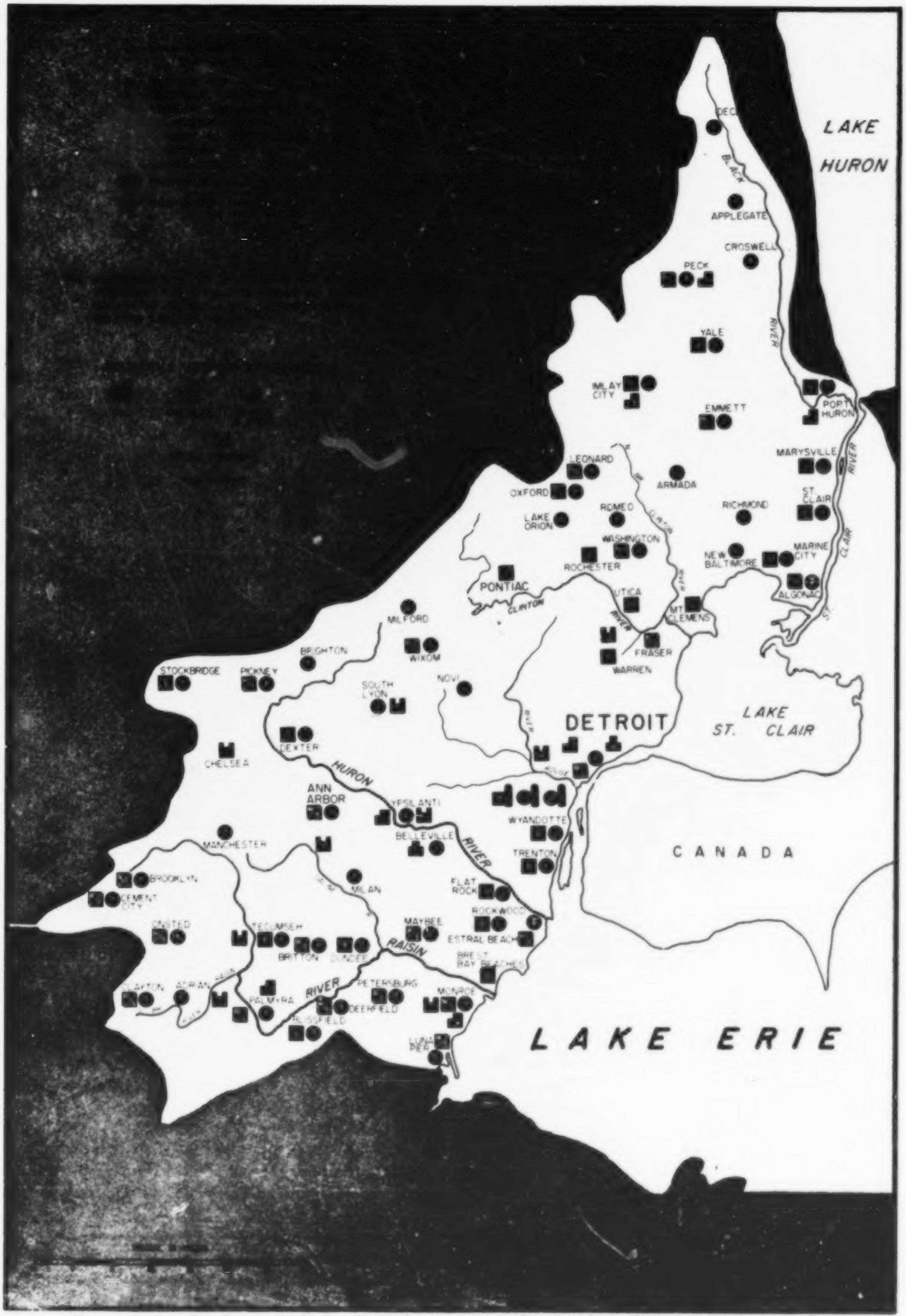

LAKE HURON
DECK
BLACK RIVER
APPLEGATE
CROSWELL
PECK
YALE
IMLAY CITY
EMMETT
PORT HURON
MARYSVILLE
LEONARD
ARMADA
OXFORD
LAKE ORION
ROMEO
RICHMOND
ST. CLAIR
WASHINGTON
NEW BALTIMORE
MARINE CITY
ST. CLAIR RIVER
CLINTON RIVER
ROCHESTER
PONTIAC
ALGONAC
UTICA
MT. CLEMENS
MILFORD
FRASER
WIXOM
WARREN
BRIGHTON
STOCKBRIDGE
PICKNEY
SOUTH LYON
NOVI
DETROIT
LAKE ST. CLAIR
DEXTER
CHELSEA
ROUGE
HURON RIVER
ANN ARBOR
YPSILANTI
WYANDOTTE
MANCHESTER
BELLEVILLE
TRENTON
CANADA
BROOKLYN
MILAN
CEMENT CITY
FLAT ROCK
ROCKWOOD
ONSTED
TECUMSEH
MAYBEE
ESTRAL BEACH
BRITTON
DUNDEE
RAISIN RIVER
BREST BAY BEACHES
CLAYTON
ADRIAN
PETERSBURG
PALMYRA
DEERFIELD
MONROE
BLISSFIELD
LUNA PIER
LAKE ERIE

Figure 5-2 – Southeast Michigan Area Major Municipal and Industrial Waste Treatment Needs

Attention must be given to the problem of combined sewers in providing connections to the regional interceptor. The present policy of the Michigan regulatory agencies is not to approve future construction of combined systems, but a careful evaluation of older systems must also be made. Where part of a system is combined and the area is scheduled for redevelopment, separation of sewers, or other techniques which can be applied to control this pollution, should be considered as an immediate need. Extensive existing combined sewers should not be interconnected with separate sewer systems. Instead they should be isolated and their flow should enter the interceptor as an entity with provision for separate handling and treatment of overflows. The ever-increasing quantity of separate sanitary sewage could then be handled without overflow interference.

The construction of needed additional recreational areas in the upper reaches of tributaries should include water storage for low-flow augmentation. Site selection must be made with multiple use in mind, so that, for example, augmentation of flow does not reduce the reservoir to a level which prohibits boating.

In addition to the massive effort required for adequate municipal sewerage systems and treatment, similar efforts are required of industries in southeast Michigan. Most of the major industrial polluters have been cited as a result of the state-federal enforcement conference in Michigan and have agreed to necessary remedial measures. Construction of facilities is already underway and some have completed remedial facilities.

Table A-2 on page 89 is a summary of the industrial waste treatment needs for southeast Michigan. The cost of construction of these facilities is estimated at $110 million.

MAUMEE RIVER BASIN AND NORTH CENTRAL OHIO AREA

Wastes from this area, particularly those from the Maumee River basin, also affect the entire lake. Although the quantity is somewhat less than from southeast Michigan, the effect on the lake, especially from nutrients, is serious.

Expansion to secondary waste treatment facilities, plus installation of tertiary treatment at 47 locations, including Toledo, Ft. Wayne, Lima, and Elyria, are the major needs for this portion of the Lake Erie watershed.

The Toledo area and, to a certain extent, the Lorain-Elyria and Sandusky areas need master planning and consolidation and integration of municipal treatment plants and interceptor systems. The remainder of the area is predominantly rural, negating a need for basin-wide interceptor systems.

Immediate municipal sewage treatment needs are listed in Table A-3 on page 92. Figure 5-3 shows both the short and long range treatment needs for this area. The cost of the immediate needs is estimated at $68 million for the Maumee River basin and $83 million for the North Central Ohio Area.

In Toledo and in Lorain overflows from combined sewers are interfering with recreational uses of the waters. *These combined sewer overflows should presently be disinfected or provided with other means of treatment to control this pollution.* To adequately abate this pollution, a proposal that shows promise is for the construction of retention basins. For the City of Toledo the cost of such retention basins has been estimated at $20 million.

The Northwest Ohio Water Development Plan covers Ohio's portion of this area. This plan contains excellent proposals for total water resource planning, including water supply, low-flow augmentation, and pollution abatement needs to the year 2000. FWPCA recommends minor modifications in this plan to take into account the need for metropolitan control in the Toledo, Lorain-Elyria, and Sandusky areas.

Since this area presently needs no further development plans, the States of Ohio and Indiana now have sufficient programs to implement the suggested controls. Already Ohio has taken steps to implement recommendations in the Northwest Ohio Water Development Plan.

Industrial wastes require a very high degree of treatment in this region. Most industries are aware of the acute problems caused by their wastes and have programs which, when put into effect, will nearly eliminate their waste problems. For example, Sohio at Lima is spending more than a million dollars a year for operating costs of its treatment facilities.

The industrial problems are caused mainly by BOD, oils, phenols, ammonia, and solids. The waste discharge loadings from several industries are small, but due to the extremely low stream flows in many areas, these loadings may be detrimental.

The cost of industrial waste abatement is estimated at $15 million for each basin. Table A-4 on page 96 lists the immediate industrial waste treatment needs for the area.

GREATER CLEVELAND-AKRON AND NORTHEAST OHIO AREA

The intensity of pollution from the Greater Cleveland-Akron area ranks second only to that from Southeast Michigan – heavily populated and industrialized and *in great need of a master, area-wide plan for pollution abatement.* However, unlike Southeast Michigan, this area has no such plan nor

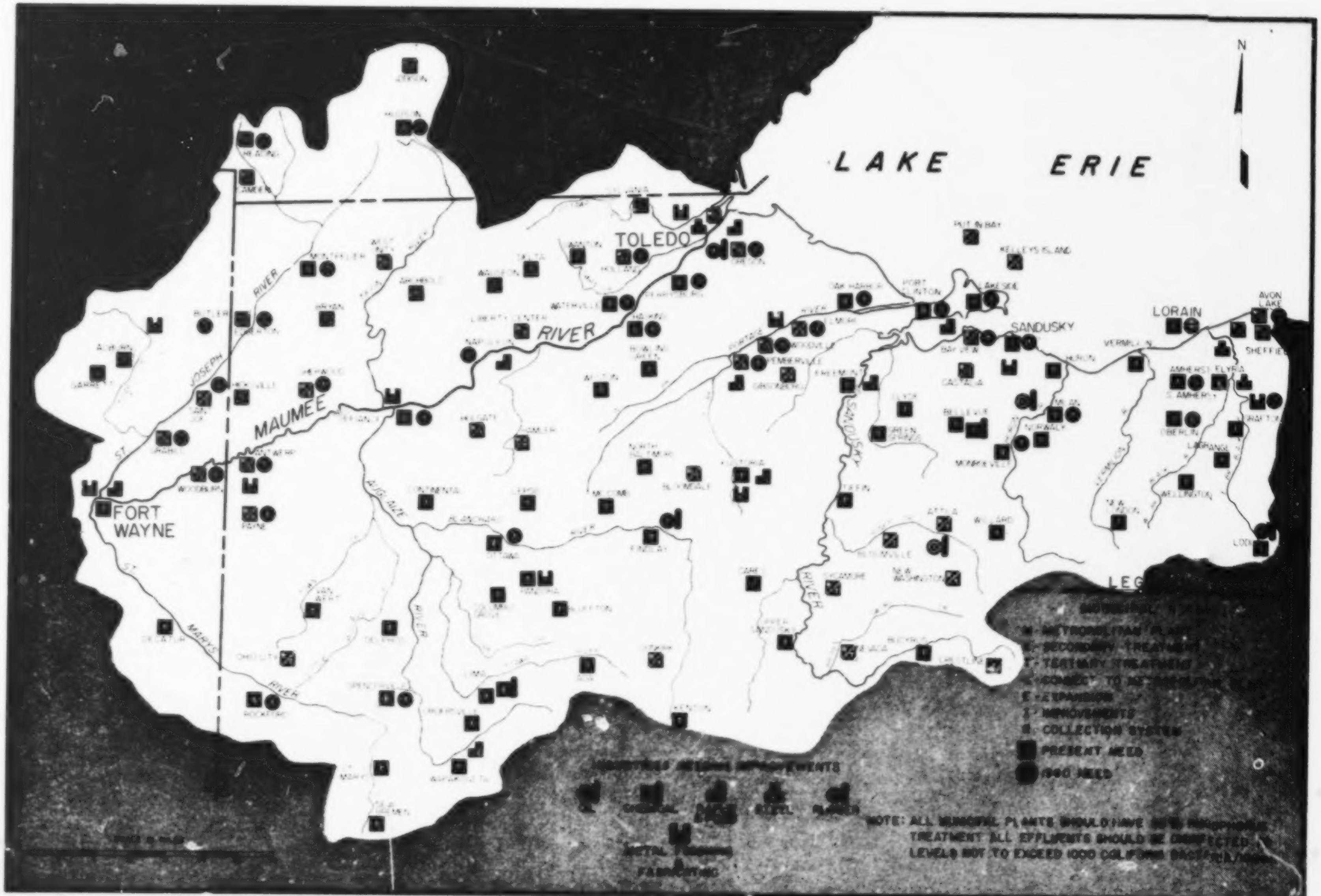

N
LAKE ERIE
TOLEDO
SANDUSKY
LORAIN
AVON LAKE
SHEFFIELD
FORT WAYNE
MAUMEE RIVER
ST. JOSEPH RIVER
ST. MARYS RIVER
AUGLAIZE RIVER
BLANCHARD RIVER
SANDUSKY RIVER
PORTAGE RIVER
VERMILION
HURON
PORT CLINTON
PUT IN BAY
KELLEYS ISLAND
LAKESIDE
BAY VIEW
CASTALIA
BELLEVUE
NORWALK
MONROEVILLE
MILAN
AMHERST
ELYRIA
S. AMHERST
OBERLIN
LAGRANGE
GRAFTON
WELLINGTON
NEW LONDON
LODI
OAK HARBOR
ELMORE
WOODVILLE
PEMBERVILLE
GIBSONBURG
FREMONT
CLYDE
GREEN SPRINGS
TIFFIN
ATTICA
WILLARD
REPUBLIC
NEW WASHINGTON
SYCAMORE
UPPER SANDUSKY
NEVADA
BUCYRUS
CRESTLINE
CAREY
KENTON
ADA
LIMA
FINDLAY
FOSTORIA
BLOOMDALE
NORTH BALTIMORE
McCOMB
LEIPSIC
OTTAWA
CONTINENTAL
COLUMBUS GROVE
PANDORA
BLUFFTON
DELPHOS
VAN WERT
OHIO CITY
SPENCERVILLE
WAPAKONETA
ST. MARYS
NEW BREMEN
CELINA
ROCKFORD
DECATUR
WOODBURN
ANTWERP
PAULDING
PAYNE
DEFIANCE
HICKSVILLE
HOLGATE
HAMLER
NAPOLEON
LIBERTY CENTER
WAUSEON
DELTA
SWANTON
ARCHBOLD
WEST UNITY
BRYAN
MONTPELIER
BUTLER
EDGERTON
AUBURN
GARRETT
SHERWOOD
HUDSON
HILLSDALE
READING
CAMDEN
WATERVILLE
HASKINS
BOWLING GREEN
WESTON
PERRYSBURG
MAUMEE
OREGON
SYLVANIA
HOLLAND
LEGEND
MUNICIPAL NEEDS
M - METROPOLITAN PLANT
S - SECONDARY TREATMENT
T - TERTIARY TREATMENT
C - CONNECT TO METROPOLITAN
E - EXPANSION
I - IMPROVEMENTS
S - COLLECTION SYSTEM
PRESENT NEED
1980 NEED
INDUSTRIES NEEDING IMPROVEMENTS
OIL
CHEMICAL
PAPER & FOOD
STEEL
PLANTS
METAL FORMING & FABRICATING
NOTE: ALL MUNICIPAL PLANTS SHOULD HAVE [illegible] PHOSPHORUS TREATMENT. ALL EFFLUENTS SHOULD BE DISINFECTED TO LEVELS NOT TO EXCEED 1000 COLIFORM BACTERIA/[illegible]

Figure 5-3 – Maumee River Basin and North Central Ohio Area Major Municipal and Industrial Waste Treatment Needs

does any local agency exist to implement a regional plan.

The State of Ohio should develop a plan for this area using the approach taken in the development of the plan for Northwest Ohio. In addition, the following immediate steps should be taken to control pollution:

1. *The Cleveland and Akron areas should form metropolitan authorities* and by 1990, when the areas merge, the two authorities should consolidate.
2. *Proliferous construction of small sewage plants should be halted.* With this in mind all sewage plants in the Rocky and Chagrin Rivers should be phased out and the municipalities connected to metropolitan treatment plants and regional interceptors in accordance with the treatment needs shown graphically in Figure 5-4, and listed in Table A-5 on page 99. As an alternate but less desirable approach, the cities on the Rocky and Chagrin Rivers could expand to tertiary treatment.
3. To *control pollution from overloaded combined sewers*, treatment methods must be devised that will fit within the financial means of the area. At this time construction of large offshore retention basins to store and treat the urban runoff seems to be the most feasible approach. A study is underway, financed by the FWPCA, to determine precisely the engineering and economic feasibility of such a proposal. Precise costs of such a proposal are not known but are believed to be over $100 million for Cleveland.
4. *Sewer discharges, especially those directly to Lake Erie should be disinfected,* beginning immediately, to reduce the bacterial hazard to recreational uses.
5. *Cleveland also needs extensive repairs and maintenance of its sewer system* to prevent bypassing of raw sewage, even during dry weather, especially in the Doan Brook and Dugway Creek areas. To partially relieve the overloaded sewers, the city's consultants have proposed the construction of express sewers (estimated cost $20 million) directly to the treatment plants from areas served by separate sewers.

Major pollution in Northeast Ohio occurs at the mouths of the tributaries where industry and municipalities are located. Chemical pollution from industry is particularly severe at Fairport, Painesville, and Ashtabula. There are also small isolated problems upstream in the larger tributaries.

Sewer systems and treatment plants should be consolidated into one collection system with secondary treatment discharging directly to the lake, for the cities of Fairport, Painesville, Painesville East, and Grand River. An alternate but less desirable approach would be for each city to construct its own secondary treatment facilities. Treatment needs in other areas primarily include expanding to secondary treatment, providing collection systems, and disinfecting municipal plant effluents.

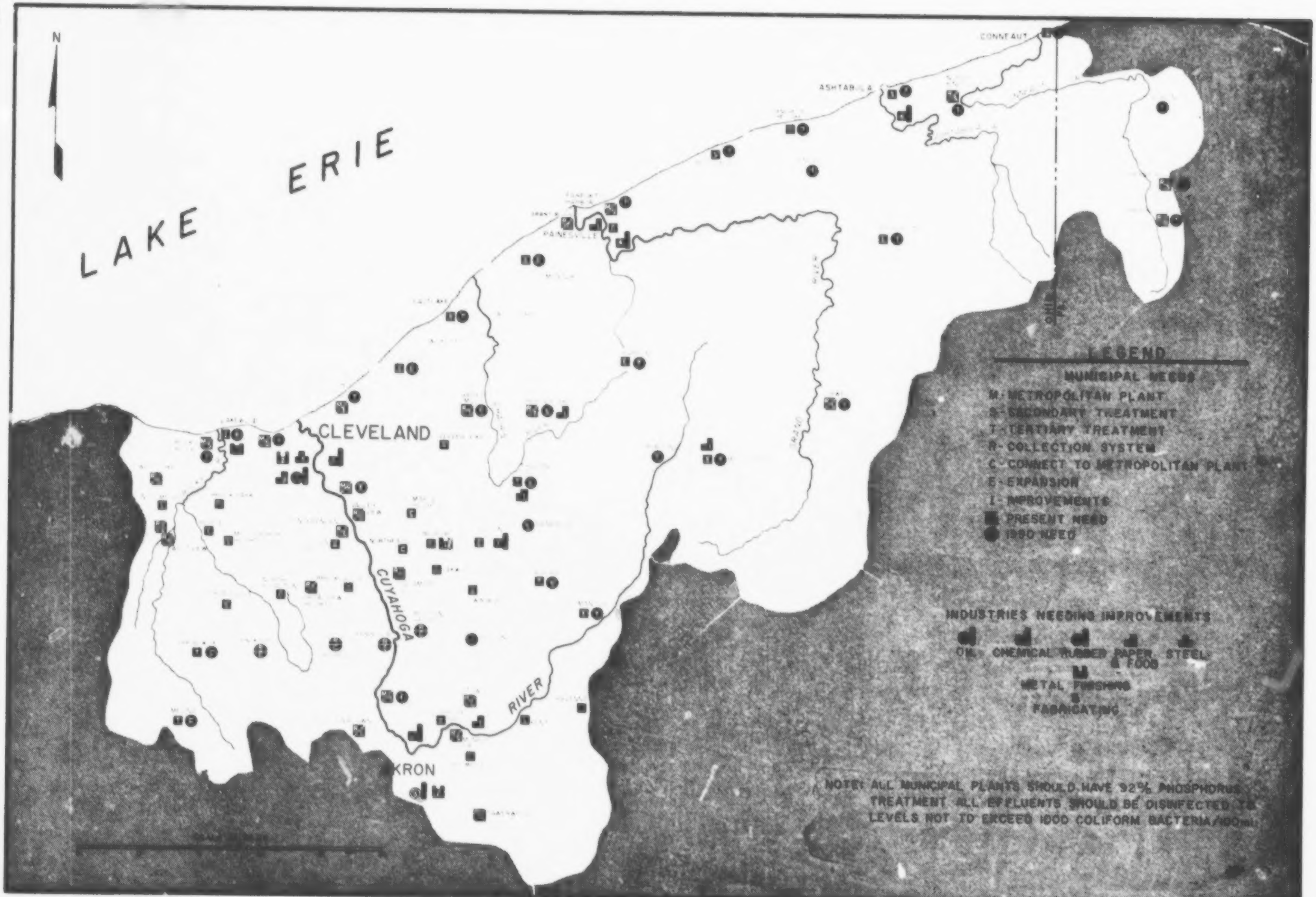
The immediate municipal pollution control needs for the Greater Cleveland-Akron and Northeast Ohio Areas are given in Table A-5, page 99, and are shown graphically in Figure 5-4. The cost to meet these needs is estimated to be $220 million for the Greater Cleveland-Akron area and $22 million for Northeast Ohio.

The Northeast Ohio area does not need, in the near future, metropolitan authorities or master plans such as those for Southeast Michigan and the Greater Cleveland-Akron area.

The principal areas of industrial pollution are the Cuyahoga River in the vicinity of Akron caused by the rubber industry and the lower Cuyahoga River at Cleveland caused by the steel industry. The waste discharges from several of the industries are small, but are important due to extremely low stream flows. The major industrial pollution materials which enter the area's waters are: solids, toxic materials, nitrogen compounds, refractory organic compounds, iron, acid, oil, heat, and color.

The principal industrial waste problem of Northeast Ohio is the disposition of soluble chemicals from the chemical industries at Fairport, Painesville, and Ashtabula. These chemicals are not removed by the usual biological waste treatment methods. The most logical methods for their removal include evaporation, recovery and utilization in the form of some marketable product, deep-well disposal, and in-plant control through process change, conservation of materials, good housekeeping, and source control. Other industrial waste problems involve settleable materials and organic waste loads, and are amenable to treatment by established methods using equipment and procedures that are readily available.

Industrial waste treatment needs for the Greater Cleveland-Akron and Northeast Ohio Areas are given in Table A-6 on page 101. Expenditures necessary to abate industrial pollution in Northeast Ohio will depend upon control measures adopted by the industries. The cost of construction for industrial facilities in the Greater Cleveland-Akron area is estimated at $90 million and $15 million for Northeast Ohio.


N
LAKE ERIE
CONNEAUT
ASHTABULA
PAINESVILLE
CLEVELAND
CUYAHOGA
RIVER
AKRON
OHIO
PA
LEGEND
MUNICIPAL NEEDS
M-METROPOLITAN PLANT
S-SECONDARY TREATMENT
T-TERTIARY TREATMENT
R-COLLECTION SYSTEM
C-CONNECT TO METROPOLITAN PLANT
E-EXPANSION
I-IMPROVEMENTS
■ PRESENT NEED
● 1980 NEED
INDUSTRIES NEEDING IMPROVEMENTS
OIL
CHEMICAL
RUBBER
PAPER & FOOD
STEEL
METAL FINISHING & FABRICATING

NOTE: ALL MUNICIPAL PLANTS SHOULD HAVE 92% PHOSPHORUS TREATMENT ALL EFFLUENTS SHOULD BE DISINFECTED TO LEVELS NOT TO EXCEED 1000 COLIFORM BACTERIA/100ml

Figure 5-4 -- Greater Cleveland-Akron and Northeastern Ohio Areas Major Municipal and Industrial Waste Treatment Needs

GPO 808-895

PENNSYLVANIA AND NEW YORK AREAS

The greatest need is in the Buffalo area for a long-range, area-wide master sewer and treatment plan. This plan should cover the entire Niagara Frontier area as well as the drainage to the Buffalo River and other tributaries to Lake Erie.

Centralized treatment should be provided at an expanded secondary treatment plant at Buffalo. Many small treatment plants now dot the area especially in the suburbs surrounding the large cities. The long range plan should call for phasing out these small plants and connecting to the large municipal system. Also, the plan should call for intercepting most of the municipal waste drainage in the Buffalo River watershed.

The plan should also consider intercepting the municipal waste drainage of Eighteenmile Creek with centralized treatment at the mouth of the creek. An entirely new secondary treatment plant should be built there.

This area is now being actively studied by the Erie-Niagara Water Resources Regional Planning and Development Board. This board was set up under article 5 of the New York State Conservation Law. Its purpose is to facilitate water resources planning on a basin basis. Also, country-wide comprehensive sewerage studies are underway in the New York counties of Erie and Niagara. These studies are being conducted under Section 1263-a of the New York State Public Health Law and are supported by 100% state grants.

A metropolitan system should be considered for the Dunkirk-Fredonia area. This would require a secondary treatment plant in Dunkirk with discharge to Lake Erie.

At Gowanda, New York, a tertiary treatment plant is needed of sufficient capacity to accept the pretreated waste discharged by the Moench Tannery and the Peter Cooper Glue Works.

At Erie, Pennsylvania, the greatest need is large scale expansion of the existing secondary treatment facilities to accept the pretreated waste from the Hammermill Paper Company, one of the largest industrial waste producers in the Lake Erie basin.

Municipal waste treatment needs for the major communities of the New York-Pennsylvania area are given in Table A-7 on page 104. Both municipal and industrial needs are illustrated in Figure 5-5. The construction cost of the recommended immediate needs for the Pennsylvania area is $10 million and for the New York area, $50 million.

The principal industrial waste treatment needs for this area are control of steel, chemical and oil wastes in the Buffalo area, control of wastes from a glue works and tannery at Gowanda, New York, and treatment or control of pulp and paper wastes at Erie, Pennsylvania. The industrial waste treatment needs, estimated cost – $5 million for the Pennsylvania area and $35 million for the New York area, are listed in Table A-8, page 106.

It is recommended that careful consideration be given to Bethlehem Steel's proposal to use its slag (a disposal problem in itself) to build a dike along the entire waterfront area of the plant, enclosing the area around Smoke Creek and South Ditch for a large final treatment lagoon. This lagoon should not replace treatment facilities planned or under construction within the plant, but should serve as an effluent polishing device and as emergency treatment in case of spills or equipment breakdown.

The answer to Hammermill's problem is to discharge pretreated wastes to the Erie, Pennsylvania, sewage treatment plant. Erie's plant should be expanded to accept this additional load.

OTHER NEEDS

The expenditious implementation of the enforcement requirements and the water quality standards is uppermost, but other needs must also receive immediate attention if success is to be achieved.

Intrastate Water Pollution Control Institutions. The water quality programs of some of the states do not consider areas where more positive control over certain waste sources is required. These include wastes from marinas and vessels, dredging operations, mining operations, feed lots, agricultural runoff, and flood plain zoning. These omissions indicate the necessity for changes in the State programs or statutes to permit more efficient control of all sources of water pollution.

In a similar vein, enabling legislation should be sought which would provide for the establishment of effective methods of dealing with the complexity of problems in the metropolitan areas of the basin. The State pollution control agencies should provide the leadership in these areas in relating waste treatment to the broader planning of the total urban environment.

Surveillance. Adequate water quality surveillance is essential to quickly identify compliance with water quality standards, document violations for corrective actions, and to identify new pollution trends, sources, and types before problems develop. The State agencies of the basin, acting in their own behalf, through local governments, and the private sector have the primary responsibility within their borders for maintaining a surveillance network capable of handling emergency pollution problems, locating and defining new problem areas and reporting on scheduled progress. Because Lake Erie is both an interstate and international body of water, the Federal Water Pollution Control Admini-

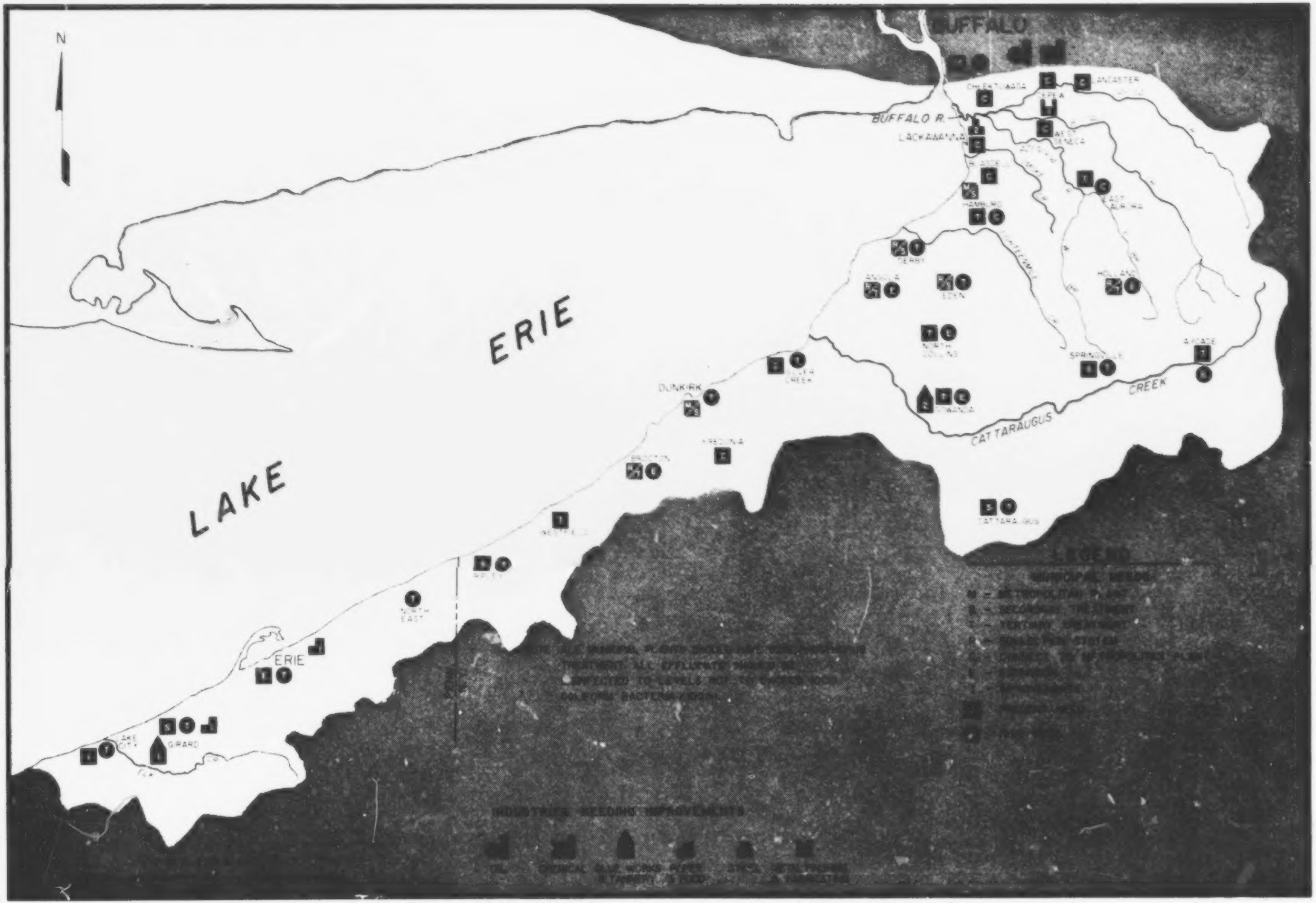

N
BUFFALO
CHEEKTOWAGA
DEPEW
LANCASTER
BUFFALO R.
LACKAWANNA
EAST SENECA
HAMBURG
EAST AURORA
DERBY
ANGOLA
EDEN
HOLLAND
NORTH COLLINS
SPRINGVILLE
ARCADE
SILVER CREEK
DUNKIRK
GOWANDA
CREEK
CATTARAUGUS
FREDONIA
BROCTON
CATTARAUGUS
WESTFIELD
RIPLEY
NORTH EAST
ERIE
GIRARD
LAKE CITY
LAKE
ERIE
LEGEND
MUNICIPAL NEEDS
M – METROPOLITAN PLANT
S – SECONDARY TREATMENT
T – TERTIARY TREATMENT
C – CONNECT TO METROPOLITAN PLANT
COLIFORM BACTERIA/100ml.
INDUSTRIES NEEDING IMPROVEMENTS
OIL
CHEMICAL
GLUE WORKS & TANNERY
PAPER & FOOD
STEEL
METAL FINISHING & FABRICATING

Figure 5-5 – Pennsylvania and New York Areas Major Municipal and Industrial Waste Treatment Needs

stration and other Federal agencies share responsibilities with the states for surveillance on the lake.

Review of Progress and Updating. To give meaning to surveillance action, the Federal Water Pollution Control Administration and the affected interstate, State, and local agencies must review progress, assess its adequacy, and make necessary revisions in the implementation plans. In particular, attention must be directed toward progress in Southeast Michigan, the Greater Cleveland-Akron area, and the Maumee River basin where problems are most significant. A continuously updated plan is necessary for attaining the goal of a clean Lake Erie basin.

Dredged Spoils and Erosion Control. The dredging of ports and waterways for the maintenance of navigation requires the disposal of large quantities of dredged spoils. Current disposal practices in Lake Erie result in pollution of large areas of the lake by redistribution of dredged sludges and silt. The Corps of Engineers and the Federal Water Pollution Control Administration should continue joint efforts in determining ways and means for curbing this pollution. The solution to this problem may require huge lakefront developments.

Control of soil erosion would aid measurably in reducing the need for dredging. The Soil Conservation Service should concentrate and expand its activities in this field and support research directed to preventing silt deposits in the lake and its tributaries. A tool for areas such as the Maumee basin with soil erosion problems is the Watershed Protection and Flood Prevention Act, Public Law 566. For the purpose of this act the Maumee basin has been divided into 27 small watersheds, each with needs for controlling soil runoff. To date only one of the drainage areas, the Little Auglaize River basin, has been project-funded by Congress. There is an urgent need to accelerate the funding of these projects to minimize silt pollution from the Maumee and to extend these projects to other areas of need. The cost of the 27 small watershed protection projects in the Maumee basin is estimated at $180 million. These projects would reduce the silt load by 80 percent. Similarly all agencies – Federal, State, and local – involved in construction should invoke measures to prevent erosion at construction projects. This problem has recently been recognized by the Bureau of Public Roads in connection with highway construction in the Cleveland metropolitan area.

Oil and Gas Well Drilling in Lake Erie. The States of Ohio, Pennsylvania, and New York are currently considering leasing underwater lands in Lake Erie for oil and gas exploration. No deleterious wastes from these operations should be allowed in the lake. All wastes should be barged ashore for disposal using State-approved sites and procedures. If considerable quantities of oil are encountered in drilling, the risk of oil pollution will be of the highest degree with the potential existing for a disaster. The guaranteed protection from such happenings is absolutely mandatory. Therefore, the States and drilling companies should provide controls that guarantee the complete absence of oil from the lake.

Research and Development. Research and development programs on more efficient, and more economical methods of tertiary treatment and nutrient removal, especially phosphorus, are needed now. The water quality standards implementation plans call for maximum practicable phosphorus removal consistent with available technology. Although some advances through modifications of secondary treatment plants and use of chemicals to achieve better phosphorus removal have been made in recent years, much more attention needs to be focused on this problem if the aging of Lake Erie is to be substantially slowed. The Federal responsibility for this work rests with the Federal Water Pollution Control Administration. In the private sector, industry in concert with government must accelerate the search for a solution to the phosphorus problem associated with detergents.

A research responsibility of the Federal Water Pollution Control Administration is to define more clearly the relationship of bottom sediments to the lake pollution problem.

Research should be carried out to define more exactly the causes of fish mortalities in Lake Erie manifested in both sudden and dramatic fish kills and in the slow unperceived disappearance of desirable species. The Federal responsibility for this rests with the U.S. Fish and Wildlife Service.

Research is needed to find methods to eliminate pollution from storm and combined sewer overflows.

The Federal Water Pollution Control Administration should consider in its research needs a final solution to the disposal of sewage and industrial sludges that will result from the more refined and advanced treatment systems.

Another research need is to find effective means to prevent the formation of oxygen-deficient zones in mid-Lake Erie.

Training. The construction of waste treatment facilities alone does not insure the elimination of pollution. Satisfactory operation of these sophisticated plants consistent with design specifications requires trained personnel. Failure to provide the required manpower could delay the entire pollution control effort in the basin.

The Federal Water Pollution Control Administration recently reported to Congress on the "Manpower and Training Needs in Water Pollution

Control." This report outlines the assistance available from the Federal government for training personnel. This assistance ranges from utilization of on-going training programs at various locations throughout the country to utilization of state program grant funds for training purposes. The States are encouraged to participate in these training programs to the maximum extent possible.

Strengthening of State Regulatory Programs. The high stakes at issue in Lake Erie, the requirements of the water quality standards program, and the growing Federal and State monetary investment in local waste treatment facilities (and in private facilities, through tax write-offs and other financial inducements) all combine to underscore the urgent need for increased enforcement, operator training, technical assistance, research, direction, closer supervision of the performance of waste treatment at the local level, and better planning for overall water quality management. This will come only if the States greatly strengthen their own will and ability to carry out these functions.

To do so, the staff and monetary resources of the State water pollution control agency in each State must be greatly expanded. Ohio particularly must strengthen the support given its water pollution control agency.

Coordination with Canada. Successful clean-up of Lake Erie's present pollution and effective management of its future water quality will require U.S.–Canadian agreements and cooperation. Indications that such will be forthcoming are available in Canadian and United States assent to and participation in an investigation of pollution in Lake Erie now underway by the International Joint Commission. This investigation, requested jointly by the Government of Canada and the Government of the United States in 1964, will culminate in a report from the IJC which will include recommendations for needed remedial measures in pollution control in both countries.

Acceptance and adoption of the report, which is scheduled for completion in 1969, by the two countries, thus would launch a joint coordinated U.S. and Canadian program to manage Lake Erie's water quality.

To further improve coordination with Canada in controlling pollution in Lake Erie, the Federal Water Pollution Control Administration suggests to the Department of State that the present report be transmitted as soon as possible to the International Joint Commission and Canadian water pollution control agencies for information and appropriate consideration.

The Future. Beyond the urgent steps previously mentioned awaits an equally important challenge – that is to devise the new institutions and new technical controls which an emerging era of more intensive and complex water quality management will require. The states have the responsibility and the authority now to accomplish the job, but they lack manpower and finances. However, a look ahead is needed to develop a single sophisticated water quality management and technological entity to replace the present division among five U.S. states, a Canadian province, several Federal agencies, and literally hundreds of local governmental agencies and private interests.

Dredging Lake Erie. A possible step to the immediate improvement of Lake Erie, in addition to the previous recommendations, is the dredging of the lake bottom. This would be the ultimate in refinement of water quality in the lake.

The cost to dredge the top three feet of sediments would be many billions of dollars and would take many decades to accomplish. Because of the complete absence of knowledge about actual benefits of such an undertaking and the great expense, this is considered impractical. The FWPCA does not believe that it will be necessary to remove bottom sediments in order to restore Lake Erie water quality. Even if such a project were undertaken, the disposition of the dredged material would be a major problem.

CHAPTER 6

THE COST OF POLLUTION CONTROL

The price of water pollution control is high – very high. The more treatment required and the more sewers that are needed, the higher the cost. The cost for controlling water pollution is indirectly associated with desired water quality and directly associated with the treatment required to obtain this quality.

In addition to the capital expenditures for present treatment facilities, some $40 million are spent annually to maintain and operate these sewerage systems. With increase in population and per capita water use and the corresponding increase in nutrient and oxygen-demanding loads, *the present plants, sewers and associated operating costs will soon become grossly inadequate* to maintain even the existing water quality. Without improvements and expansions, Lake Erie would quickly become a virtual cesspool and its tributaries something worse. It should be noted at the start that, due to increasing costs, the longer such construction is delayed the greater the expense will be.

MUNICIPAL WASTE TREATMENT COSTS

The Lake Erie Enforcement Conference in 1965 required that secondary treatment be provided at all municipalities. This requirement necessitates marked improvements in present treatment facilities and requires the construction of many new treatment plants and sewer systems. The cost for this increased treatment will be the minimum expenditure that will bring at least temporary improvement to the lake and tributary water quality.

The cost of secondary treatment at all municipalities will be higher because of the need for additional sewers and because of the need for entire treatment facilities in the areas presently providing nothing more than individual septic tanks. *Although secondary treatment is a major step toward the abatement of water pollution, it is only a portion of the requirements necessary to bring water quality in the tributaries to a desired state.*

Figure 6-1 and the explanations that follow indicate water quality improvements and costs that can be expected for increasing levels of treatment ranging from the minimum of overall secondary treatment to overall advanced waste treatment and control of agricultural runoff and combined sewer overflows.

These *cost estimates, which are for municipalities only, do not include land costs, assume 100 percent municipal financing (i.e. no aid from State or Federal governments) and are based on the present value of the dollar.* The immediate costs are based on treatment facilities to meet the 1990 population and presently unsewered areas. The additional cost in 1990 is for expansion of sewer systems to meet population growth through 1990, and treatment plants to meet the needs of the 2020 population. Per capita costs include amortization of construction costs and costs for operating and maintaining the sewerage systems.

All construction costs are based on formulas from Public Health Service Publication No. 1229 – *Modern Sewage Treatment Plants – How Much Do They Cost?* (February 1965). Advanced waste treatment costs for rural areas were assumed similar to those of stabilization lagoons and for urban areas equivalent to an additional secondary treatment plant.

Operational costs are based on known expenditures and formulas from an article appearing in the February 1961 issue of the *Water Pollution Control Federation Journal* entitled "Estimating Sewage Treatment Plant Operation and Maintenance Costs" by P.P. Rowan, K.L. Jenkins and D.H. Howells.

In addition the cost data are consistent with the Department of the Interior report titled, "Cost for Clean Water" published January 10, 1968.

The first three levels of treatment that follow are similar in total construction costs, the only difference being the expenditure necessary for the additional municipal waste treatment required in the second and third cost levels. The major construction expense, which is for sewers, is constant for all three levels of treatment. The cost for sewers is approximately $700 million for immediate needs and another $1 billion to meet population growth by 1990.

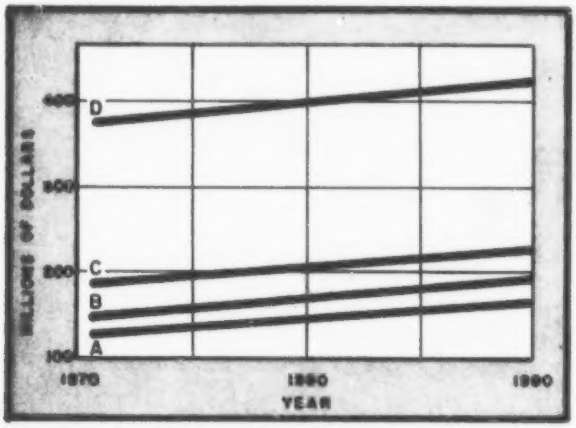


Figure 6-1 – Noncumulative Annual Treatment Costs Through 1989

A. SECONDARY TREATMENT AT ALL PLANTS

As mentioned earlier *secondary treatment at all plants is the minimum program that would show improvement in water quality in the Lake Erie basin.*

Construction cost for providing adequate secondary treatment and sewers at all municipalities in the Lake Erie basin is $1 billion. Another $1.41 billion will be required to expand the facilities in 1990. After initial construction is completed, the capital expenditures paid over thirty years and operating cost will increase present annual per capita expenditures by $5-6, which includes up to $1 per capita per year to maximize phosphorus removal.

With secondary treatment and phosphorus removal at all plants, most tributaries and certainly Lake Erie will have improved water quality. The persisting problems will be the oxygen demand from organic discharges near the headwaters of tributaries and in those streams which have low flow during the summer. Under these circumstances there is very little water in the stream to dilute the waste discharge and, as a result, otherwise insignificant loads may cause degraded conditions. Higher removal rates must be required to minimize these loads as much as possible. To alleviate these problems, tertiary treatment (advanced waste treatment) should be provided at some locations.

B. FWPCA RECOMMENDATIONS

The FWPCA recommendation is basically secondary treatment with the addition of advanced waste treatment at 67 treatment plants. The addition of advanced waste treatment (which can remove in excess of 95 percent of the BOD and phosphorus) is recommended by the FWPCA at those locations where greater removal of oxygen-demanding materials is immediately necessary. The FWPCA further recommends that by 1990 in order to meet population growth, all municipalities in the Lake Erie basin should provide advanced waste treatment. The individual immediate recommendations are discussed in the recommendations chapter of this report.

This program is providing control for increasing waste loads as population grows will provide substantial improvements to both lake and tributary waters. With this, swimming and fishing -- which are now restricted activities -- will increase to near their full potential. More important, however, is that the destructive pollution pace will be greatly diminished, giving the natural self-purification phenomena a chance to bring Lake Erie to a much more desirable state.

The immediate construction costs for carrying out this program will be $1.10 billion, with an additional $1.70 billion for the improvements and expansion required by 1990. This represents an approximate increase in present annual per capita expenditures of $7. Figure 6-2 shows the construction cost by state for the immediate treatment and sewer needs of municipalities in the Lake Erie basin.

C. ADVANCED WASTE TREATMENT AT ALL PLANTS

This would be the same as the FWPCA recommendations with the addition of advanced waste treatment at the remaining treatment plants. The approximate cost for advanced waste treatment throughout the basin would be $1.24 billion for present needs and $1.56 billion additional for expansions by 1990.

This will provide basically the same benefits as in *B* since the additional treatment will remove more oxygen-demanding material in areas where this is not an immediate need.

Since the end result for both *B* and *C* is the same, namely advanced waste treatment basin-wide, the total construction cost will be essentially equal. However, average per capita costs will be lower in *B* because the increased operation cost for advanced waste treatment will not be needed until 1990. Advanced waste treatment at all plants will increase the present expenditures by $10 per capita per year (compared to $7 increase per capita per year for FWPCA recommendation).

D. ADVANCED WASTE TREATMENT, CONTROL OF AGRICULTURAL RUNOFF AND CONVERSION OF COMBINED SEWERS TO SEPARATE SEWERS

In addition to *C*, this program will increase construction costs to $5 billion. On the whole this project is more idealistic than practical. However,

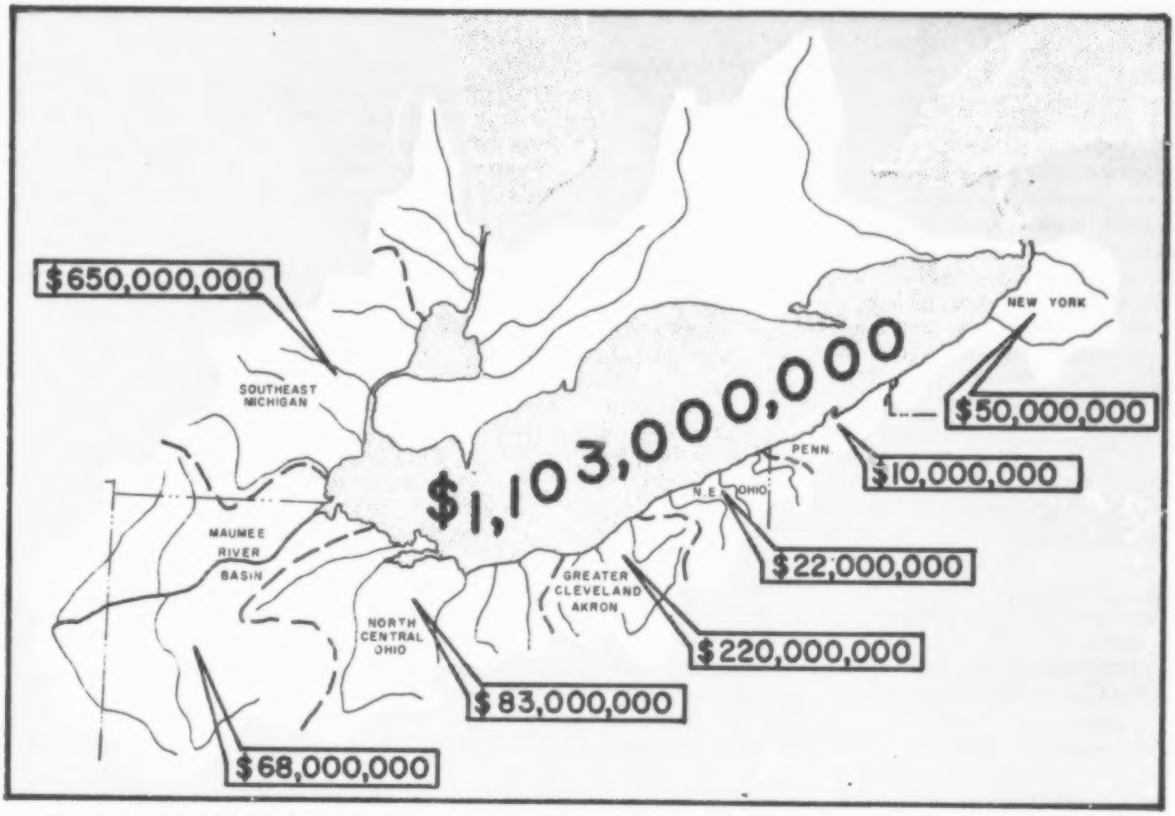

$650,000,000
SOUTHEAST MICHIGAN
$1,103,000,000
NEW YORK
$50,000,000
PENN.
$10,000,000
N.E. OHIO
$22,000,000
MAUMEE RIVER BASIN
GREATER CLEVELAND AKRON
$220,000,000
NORTH CENTRAL OHIO
$83,000,000
$68,000,000

Figure 6-2 – Construction Costs for FWPCA Recommended Municipal Immediate Needs

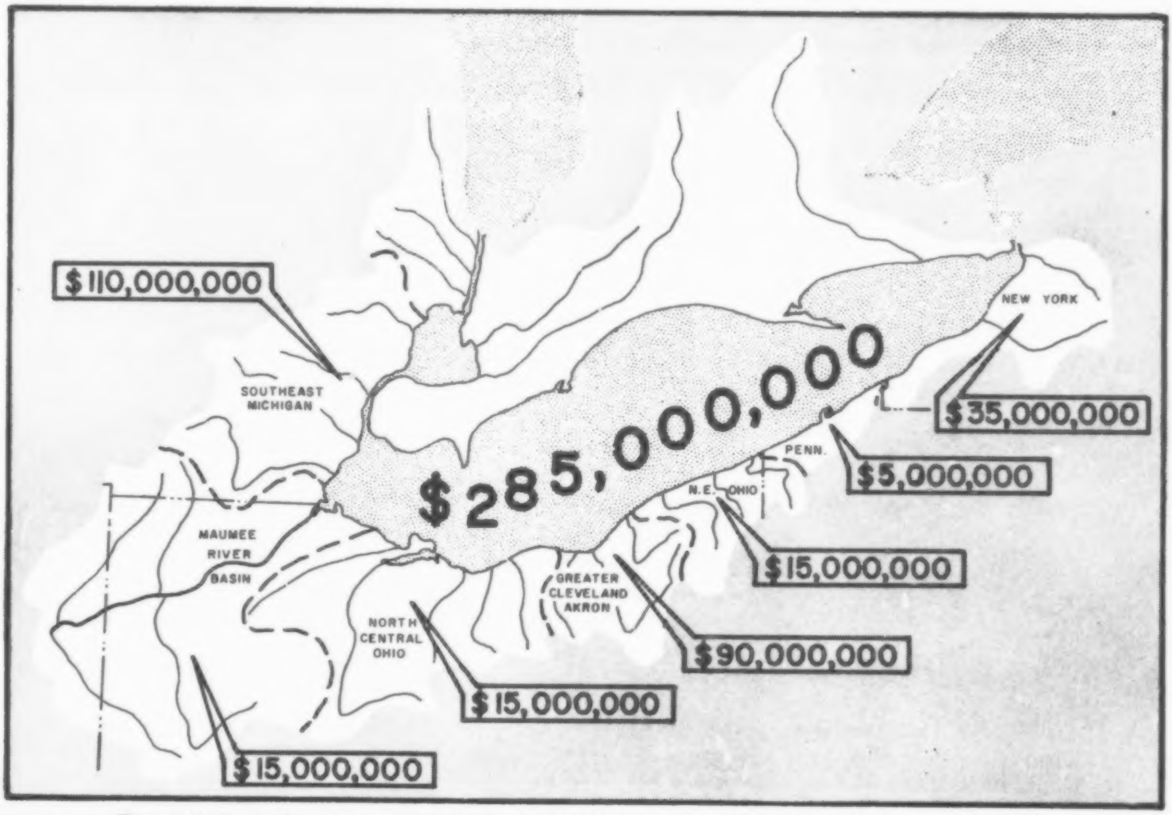

$110,000,000
SOUTHEAST MICHIGAN
$285,000,000
NEW YORK
$35,000,000
PENN.
$5,000,000
N.E. OHIO
$15,000,000
MAUMEE RIVER BASIN
GREATER CLEVELAND AKRON
$90,000,000
NORTH CENTRAL OHIO
$15,000,000
$15,000,000

Figure 6-3 – Construction Costs for FWPCA Recommended Industrial Immediate Needs

portions or modifications are practical and are, in fact, recommended by the FWPCA as immediate needs.

One such recommendation is the control of agricultural runoff. In order to control silt loads from agricultural lands, it is estimated that some $400 million must be spent on projects such as underdrains, check dams, channel improvements, and grassing slopes of waterways. Such a long-term project will have an annual per capita cost of $2-3 (similar to present per capita expenditures for operation of sewage treatment plants.)

This investment for *agricultural runoff control is probably as necessary as any of the municipal and industrial treatment recommendations* since such runoff contains large amounts of nutrients, oxygen-demanding material and possibly toxic substances such as pesticides, insecticides, and herbicides.

It should be noted that maximum control of agricultural runoff is not solely a need for improvements through construction, but also a need for improvements through education. Improved practices in fertilizer application, ground cover, contour farming and other erosion controls should be implemented through this educational program.

It is estimated that some $3 billion would have to be spent to convert present combined systems to separate systems, which is equivalent to an increase of $10-20 per capita per year. This cost does not reflect the time and inconvenience involved in detouring traffic away from downtown areas where most larger cities have combined sewers.

The conversion of combined sewers cannot be recommended as a basin-wide policy, but it is recommended by FWPCA in areas where feasible, such as in redevelopment projects. It is further recommended for areas where it is not feasible to remove combined sewers that, for the present, effluents from overflows should be at least disinfected before discharging to a watercourse and, in the future some form of storage and treatment should be provided.

The cost for this recommended project has not been determined but it would be substantially less than the billions of dollars required for basin-wide separation. The cost of such a project will depend on the method which each municipality determines is best suited for its specific problems and location.

INDUSTRIAL WASTE TREATMENT COSTS

The estimate of construction costs for control of industrial waste discharge is difficult to determine due to the many processes involved with such a diversity of industries located within the Lake Erie basin. Treatment needs may vary from improving in-plant operations to the addition of complex and elaborate equipment. The solution to many industrial pollution problems may be the connection to municipal treatment plants which may or may not require pretreatment.

It has been found in some instances that industries can recover a portion of the cost for improved control due to the economic value of some of the by-products of the treatment process and/or improved efficiency.

Based on area-wide industrial waste pollution problems and industrial activity, it is estimated that the immediate needs for control of industrial waste discharges will cost $285 million (Figure 6-3.)

APPENDIX

INDIVIDUAL MUNICIPAL AND INDUSTRIAL WASTE TREATMENT NEEDS

KEY TO TABLES

Status of "Control Measures Needed" and "Abatement Schedule" as of January 1, 1968. Waste data may not reflect recent additions to treatment facilities. The data were obtained during the period 1964-1966. In a few cases the data were obtained in 1967. In all cases the data are the most recent that has been supplied by the state water pollution control agency.

Type Sewerage System

S = Separate sewer system
C = Combined sewer system
S–C = Separate and combined sewer system

Waste Constituents

In pounds per day except temperature in degrees Fahrenheit and pH

Al	Aluminum
BOD	Biochemical Oxygen Demand
Ca	Calcium
Cd	Cadmium
Cl	Chlorides
CN	Cyanide
COD	Chemical Oxygen Demand
Cr	Chrome
Cu	Copper
D	Total Dissolved Solids
F	Fluoride
Fe	Iron
Mg	Magnesium
Mn	Manganese
NH_3	Ammonia
Ni	Nickel
Pb	Lead
pH	Hydrogen Ion Concentration
S	Total Suspended Solids
SiO_2	Silica Dioxide
SO_4	Sulfate
T	Total Solids
Temp	Temperature
X	Insuffficent data
Zn	Zinc

Control Measures Needed

I = Covered by interstate water quality standards and plan of implementation of State.
E = Covered by Federal-State enforcement conference for secondary treatment only.
L = May substitute secondary treatment if discharged to Lake Erie.

Abatement Schedule Established by State

NS = Unaware of any schedule
UN = Schedule under negotiation
A = For secondary treatment only
B = For additional treatment only

Footnotes

G = Have converted one line to hydrochloric acid process; all will be converted by December, 1969.
H = Contains Pure Oil Company's effluent until January 1, 1970, when Pure Oil will discontinue refining operations in Toledo.
J = Cubic feet per day

TABLE A-1

SOUTHEAST MICHIGAN AREA
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day) Raw	BOD (lbs./day) Final	Control Measures Needed	Abatement Schedule
St. Clair River						
Yale	Lagoons–C	0.24	x	x	Improvements	NS
Peck	Septic Tanks				Sewers and lagoon	NS
Deckerville	Septic Tanks				Sewers and lagoon	NS
Port Huron	Primary–C	11.70	x	x	Secondary (I)	NS
Port Huron Twp.	Septic Tanks				Connect to Port Huron sewer system (I)	UN
Marysville	Primary–S	1.14	x	x	Secondary (I)	NS
St. Clair	Primary–C	0.48	x	x	Secondary (I)	NS
St. Clair Twp.	Septic Tanks				Sewers and Secondary (I)	UN
Kimball Twp.	Septic Tanks				Sewers and Secondary (I)	UN
Emmett	Septic Tanks				Sewers and lagoon	NS
East China Twp.	Primary	0.15	x	x	Secondary	NS
Imlay City	Secondary–S	0.14	x	x	Additional sewers	NS
Marine City	Primary–C	0.65	x	x	Secondary (I)	NS
Cottrelville Twp.	Septic Tanks				Additional sewers & Secondary (I)	UN
Clay Twp. Including Algonac	Septic Tanks				Additional sewers & Secondary (I)	UN

TABLE A-1

SOUTHEAST MICHIGAN AREA (Continued)
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day) Raw	BOD (lbs./day) Final	Control Measures Needed	Abatement Schedule
Lake St. Clair						
Harrison Twp.	Septic Tanks				Connect to Metro (I)	UN
Ira Twp.	Septic Tanks				Stabilization lagoon (I)	UN
Clinton River Basin						
Mt. Clemens	Secondary–C	3.72	x	x	Connect to Metro.	UN
Clinton Twp. #1	Secondary–S	2.34	x	x	Connect to Metro.	UN
Clinton Twp. #2	Secondary–S	2.03	x	x	Connect to Metro.	UN
Fraser	Septic Tanks				Sewers & connect to Metro.	UN
Warren	Secondary–C	23.70	x	x	Connect to Metro.	UN
Sterling Twp. #1	Secondary–S	2.20	x	x	Connect to Metro.	UN
Utica	Secondary–C	0.39	x	x	Connect to Metro.	NS
Rochester	Secondary–S	0.97	x	x	Connect to Metro.	NS
Pontiac #1	Secondary–C	9.8	x	x	Connect to Metro.	NS
Pontiac #2	Secondary–C	11.4	x	x	Connect to Metro.	NS
Washington	Septic Tanks				Sewers and Secondary	NS
Oxford Village	Septic Tanks				Sewers and Secondary	NS
Leonard	Septic Tanks				Sewers and lagoon	NS
Detroit River Basin						
Detroit	Primary–C	686.9	603,600	501,000	Secondary (IE)	11/70
Wayne County (2 plants)	Primary–C	49.3	36,660	23,880	Secondary (IE)	11/70
Riverview	Primary–C	1.6	x	x	Secondary (IE)	11/70
Trenton	Primary–C	4.1	x	x	Secondary (IE)	11/70
Grosse Ile Twp.	Primary–C	0.4	150	100	Secondary (IE)	11/70
Huron River Basin						
Rockwood	Primary–C	0.32	x	x	Additional sewers & Secondary (I)	UN
South Rockwood	Septic Tanks				Sewers & Secondary or connect to Wayne County (I)	6/69
Flat Rock	Primary–C	0.34	x	x	Additional sewers & Secondary (I)	UN
Ypsilanti Twp.	Secondary–S	3.65	x	x	Connect to Metro.	NS
Superior Twp.	Septic Tanks				Additional sewers & Connect to Metro	NS
Pittsfield Twp.	Septic Tanks				Additional sewers & Connect to Metro.	NS
Huron Twp.	Septic Tanks				Additional sewers & Connect to Metro. (I)	6/69
Ann Arbor	Secondary–S	10.31	x	x	Expansion (Metropolitan System)	NS
Ann Arbor Twp.	Septic Tanks				Additional sewers & Connect to Metro.	NS
Dexter	Primary–S	0.12	x	x	Secondary	NS
Pinckney	Septic Tanks				Sewers and lagoon	NS
Stockbridge	Lagoons	0.13	x	x	Additional sewers and improvements	NS
Wixom	Septic Tanks				Sewers and Secondary	NS
River Raisin Basin						
Monroe	Primary–S	2.93	3,365	1,380	Secondary (IE)	5/69
Ash Twp.	Septic Tanks				Additional sewers & connect to Metro.	NS
Dundee	Primary–C	0.20	x	x	Secondary	NS
Petersburg	Septic Tanks				Sewers and lagoon	NS
Deerfield	Septic Tanks				Sewers and lagoon	NS
Blissfield	Primary–C	0.49	x	x	Secondary	NS
Palmyra Twp.	Septic Tanks				Additional sewers & Secondary	NS
Madison Twp.	Septic Tanks				Additional sewers & Secondary	NS

TABLE A-1

SOUTHEAST MICHIGAN AREA (Continued)
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day)		Control Measures Needed	Abatement Schedule
			Raw	Final		
River Raisin Basin (Cont'd.)						
Clayton	Septic Tanks				Sewers and lagoon	NS
Onsted	Septic Tanks				Sewers and-lagoon	NS
Tecumseh	Secondary–S	0.71	x	x	Additional sewers and expansion	NS
Britton	Septic Tanks				Sewers and lagoon	NS
Brooklyn	Septic Tanks				Sewers and lagoon	NS
Cement City	Septic Tanks				Sewers and lagoon	NS
Small Tributaries						
Maybee	Septic Tanks				Sewers and lagoon (I)	UN
Bedford Twp.	Septic Tanks				Additional sewers & lagoon (I)	UN
Erie Twp.	Septic Tanks				Additional sewers & lagoon (I)	UN
Direct to Lake Erie						
Luna Pier	Septic Tanks				Sewers and Secondary (IE)	5/69
Estral Beach	Septic Tanks				Sewers and Secondary (IE)	5/69
Berlin Twp.	Septic Tanks				Sewers and Secondary (IE)	5/69
Frenchtown Twp.	Septic Tanks				Sewers and Secondary (IE)	5/69
Monroe Twp.	Septic Tanks				Sewers and Secondary (IE)	5/69

TABLE A-2

SOUTHEAST MICHIGAN AREA
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs/day)	Control Measures Needed	Abatement Schedule
St. Clair River Basin				
Michigan Milk Producers Assn. (Peck)	0.01	BOD x	Establish Treatment	NS
Port Huron Paper	7.10	Solids xS; BOD x	Establish adequacy of treatment	NS
Vlasic Food Products	0.10	BOD x; Chlorides x	Establish adequacy of treatment	NS
Croswell Pickle Co.	x	BOD x; Chlorides x	Establish adequacy of treatment	NS
Ray Weeks Packing Co. (Richmond)	x	BOD x	Additional Treatment	NS
Detroit Edison Co. (Port Huron)	x		Establish adequacy of treatment	NS
Clinton River Basin				
TRW-Michigan Div.	0.10	Oil x	Improve reliability of treatment of oil wastes - establish adequacy of treatment (sanitary wastes)	NS
Superior Metal Products (Auburn Hts.)	x	x	Establish adequacy of treatment	NS
Ford Motor	1.5	Solids xS; Oil x	Establish adequacy of treatment (oil and sanitary waste)	NS
Chrysler–Michigan Missile	0.55	Oil x; CN x; Heavy metals x	Establish adequacy of treatment (lagoons)	NS

TABLE A–2

SOUTHEAST MICHIGAN AREA (Continued)
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
Clinton River Basin (Cont'd.)				
Briggs Manufacturing			Establish adequacy of treatment	NS
National Machine Products Co. (Utica)	x	x	Establish adequacy of treatment	NS
National Twist Drill & Tool Co. (Rochester)	x	x	Establish adequacy of treatment	NS
Detroit River Basin				
Revere Copper & Brass	2.9	Solids 2,166S; BOD 570; Oil 2,628; Fe 3.5; Cu 100; Ni 0.4; Zn 66; Pb 0.9; Chromium 29	Suspended solids, Oil (IE)	11/67
Great Lakes Steel– Blast Furnace Div.	90.0	Solids 100,000S; BOD 3,700; Oil 2,482; Phenols 370; Fe 5,146; NH_3 2,900; CN 10; Cu 108; Zn 750; Pb 123; Chlorides 17,959	Suspended solids, Oil, Phenols (IE)	4/68
Great Lakes Steel– Not Strip Mill	72.0	Phenols 1.65; Fe 1,500; Oil 2,738; NH_3 86; Zn 42; BOD 350; Pb 280; Chlorides 1,000	Suspended solids, Oil (IE)	4/68
Great Lakes Steel– Ecorse Mill	72.0	Solids 8,400S; Oil 7,884; Phenols 1.67; Fe 49,000; Acid 158,000; Cu 137; Ni 4; Zn 12; Pb 34; Chromium 8; Chlorides 1,800	Suspended solids, Fe, Oil pH (IE)	4/69
Wyandotte Chemicals North Side Works	57.0 P	Solids 300,000S; BOD 2,200; Phenols 34.13; Cu 59; Zn 7 P 14; Chlorides 1,300,300	Suspended solids, Chlorides, Oil (IE)	4/68
Wyandotte Chemicals South Side Works	54.7	Solids 69,745S; BOD 3,000; Cu 35; Ni 1; Zn 10; Pb 7; Chromium 6; Chlorides 550,000	Suspended solids, Chlorides Oil (IE)	4/68
Pennsalt Chemical East Plant	97.0	Solids 93, 370S; Chlorides 500,000	Suspended solids, Chlorides (IE)	4/68
Pennsalt Chemical West Plant	6.8	Solids 6,500S; Chlorides 8,779; Oil 290; Phenols 60	Suspended solids, Chlorides, Oil (IE)	4/68
Firestone Tire and Rubber	1.0	Solids 296S; BOD 70; Phenols 0.19	Iron (IE)	11/67
Chrysler Corp. (Trenton)	x	x	Establish adequacy of treatment	NS
Dana Corp.	x	Solids xS; Oil x; Phenols x; pH x	Establish adequacy of treatment	NS
E. I. duPont	x	pH x	Additional treatment	NS
McLouth Steel (Trenton)	65.7	Solids 15,588S; BOD 5,000; Oil 270; Phenols 9.04; Fe 1,990; NH_3 250; CN 119; Cu 63; Ni 9; Zn 300; Pb 325; Chrom. 3; Chlor. 24,267	Suspended solids, Iron, Oil (IE)	4/68

TABLE A-2

SOUTHEAST MICHIGAN AREA (Continued)
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
Detroit River Basin (Cont'd.)				
Mobil Oil	1.1	Solids 1,588S; BOD 1,000; Oil 719; Phenols 117; Fe 2; Cu 0.7; Zn 0.5; Pb 3; Chromium 0.8; Chlorides 12,989	Suspended solids, Oil (IE)	11/67
Monsanto Chemical Plastic Products & Resins Div.	18.0	Solids 6,500S; Fe 6; Cu 3.5; Ni 0.8; Zn 0.4; P 10,000	Oxygen consuming substances (IE)	4/68
Monsanto Chemical Inorganic Chemicals	x	Solids xS; p x	Soluble Phosphate (IE)	11/69
Rouge River Basin				
Allied Chemical Solvay Process Div.	15.2	Solids 10,000S; Phenols 17.6; Cu 3.6; Zn 2.8; Pb 1.5; Chromium 0.4; Chlorides 2,800,000	Suspended solids, Chlorides (IE)	4/68
Scott Paper	43.8	Solids 31,300S; BOD 135,000; Phenols 26; Cu 114; Zn 230; Chlorides 33,600	Suspended solids, Oxygen consuming substances (IE)	1/70
American Cement Corp.	x	x	Establish adequacy of treatment	NS
Associated Spring Corp.	0.17	BOD 60; Solids 150S; Oil 37	Establish adequacy of treatment	NS
Haller Corp.	0.09	Solids 15S; Chlorides 33; Oil	Establish adequacy of treatment	NS
Ford Motor-Rouge (Rouge and Wayne Auto Assembly Plant)	400.0	Solids 62,000S; BOD 2,930; Oil 6,570; Phenols 750; Fe 19,000; NH_3 5,000; CN 900; Acid 50,000; Cu 1,500; Ni 36; Zn 275; Pb 50; Chromium 260; Chlorides 32,000	Suspended solids, Iron, Phenols, Oil (IE)	6/69
Darling & Co.	1.1	Solids 168S; BOD 7,100; Oil 158; Phenols 0.24; NH_3 135; Pb 1.0; P 5.5; Chlorides 14	Oxygen consuming substances, Coliform (IE)	11/67
Seaway Cartage	x	Solids; pH	Additional Treatment	NS
Trilex	x	Heavy Metals; Oil	Additional Treatment	NS
Evans Products	x	Oil	Establish adequacy of treatment	NS
Burroughs Corp.	x	Oil; Solids; Chlorides	Establish adequacy of treatment	NS
Huron River Basin				
Huron Valley Steel	1.1	Solids xS	Solids	NS
General Motors	0.7	Solids xS; BOD x; Chromium x	Establish adequacy of treatment (Coagulation & Lagoon)	NS
Moynahan-Stearns	x	Aluminum x; Chromate x	Additional treatment	NS
Peninsular Paper	1.6	Solids xS	Improvements	NS
Longworth Plating	0.1	pH x; Toxic metals x; Oil x	Establish adequacy of treatment	NS
Michigan Seamless Tube	0.9	Temp x	Additional Treatment	NS
Ottawa Silica Michigan Silica Div.	x	x	Additional Treatment	NS
Dana Corporation (Chelsea)	x	Oil	Establish adequacy of treatment	NS

TABLE A–2

SOUTHEAST MICHIGAN AREA (Continued)
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
Huron River Basin (Cont'd.)				
Federal Screw Works (Chelsea)	x	Oil	Establish adequacy of treatment	NS
Ford (Ypsilanti)	x	Oil	Additional treatment	NS
Lithocrafters	x	Toxicants; pH	Establish adequacy of treatment	NS
River Raisin Basin				
Ford Motor	130	Solids 8S; BOD 48; Oil 6,351; Phenols 3.8; NH_3 160; CN 1,075; Cu 700; Ni 120; Zn 125; Chromium 136; P 1,046; Chlorides 16,000	Cyanide, Soluble Phosphate, Oil, Coliform (IE)	12/68
Union Bag – Camp Paper	4.57	Solids 3,587S; BOD 11,770; Oil 672; Phenols 5.9; Fe 20; NH_3 12	Suspended Solids, Oxygen consuming substances, Coliform (IE)	1/69
Consolidated Packaging South Side Div.	7.0	Solids 10,600S; BOD 7,000; Oil 263; Phenols 0.5; NH_3 2; Zn 15; P9	Suspended Solids, Oxygen consuming substances, Coliform (IE)	1/69
Consolidated Packaging North Side Div.	7.50	Solids 7,823S; BOD 17,204; Oil 898; Phenols 11.0	Suspended Solids, Oxygen consuming substances Coliform (IE)	1/69
Time Container Monroe Div.	2.21	Solids 1,475S; BOD 1,900; Oil 36.5; Phenols 0.6; Fe 15; NH_3 3; Cu 3; Zn 93; Chlorides 120	Suspended Solids, Oxygen consuming substances Coliform (IE)	1/69
Home Canning	x	BOD x	Additional Treatment	NS
Hoover Ball & Bearing Universal Die Casting Div.	0.57	x	Additional Treatment	NS
Revco	0.3		Additional Treatment	NS
Tecumseh Products	1.44	Temp x	Additional Treatment	NS
Buckeye Products	x	Heavy Metals; pH	Additional Treatment	NS
Simplex Paper	x	BOD; Solids; Color	Additional Treatment	NS
Stauffer Chemical	x	Chlorides	Establish adequacy of treatment	NS

TABLE A–3

MAUMEE RIVER AND NORTH CENTRAL OHIO AREA
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs/day) Raw	BOD (lbs/day) Final	Control Measures Needed	Abatement Schedule
MAUMEE AREA – St. Joseph River						
Garrett, Ind.	Secondary	0.3	225	22	Provisions of adequate dilution water or installation of advanced waste treatment (I)	1977
Auburn, Ind.	Secondary	2.0	915	100	Provision of adequate dilution water or installation of advanced waste treatment (I)	1977
Waterloo, Ind.	Secondary	0.13	95	10	Disinfection (IE)	1968
Grabill, Ind.	Septic Tanks				Sewers & treatment facilities(IE)	1977
St. Joe, Ind.	Septic Tanks				Sewers & treatment facilities (I)	1977
Avilla, Ind.	Lagoon	0.05	x	x	Disinfection (IE)	1968

TABLE A-3

MAUMEE RIVER AND NORTH CENTRAL OHIO AREAS (Continued)
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day) Raw	BOD (lbs./day) Final	Control Measures Needed	Abatement Schedule
St. Joseph River (Cont'd.)						
Butler, Ind.	Secondary	0.25	187	37	Advanced waste treatment (IE)	1968(B)
Edgerton, O.	Septic Tanks				Sewers and Secondary	NS
Montpelier, O.	Primary–C	1.28	1,870	1,590	Secondary (IE)	12/69
Reading, Mich.	Septic Tanks				Sewers and Secondary	NS
Camden, Mich.	Septic Tanks				Sewers & Stabilization lagoon (I)	UN
St. Marys River						
Decatur, Ind.	Secondary	0.97	445	65	Provision of adequate dilution or installation of advanced waste treatment (I)	1977
Berne, Ind.	Lagoon	0.15	112	16	Disinfection (IE)	1968
Rockford, O.	Primary–C	0.18	160	125	Secondary (IE)	8/69
St. Marys, O.	Secondary–S	0.91	1,460	160	Advanced waste treatment (IE)	6/69(B)
New Bremen, O.	Secondary–C	0.18	170	12	Advanced waste treatment	NS
Upper Maumee River						
Sherwood, O.	Septic Tanks				Sewers & Secondary (IE)	6/69
Hicksville, O.	Secondary–C	0.35	420	35	Advanced waste treatment	NS
Antwerp, O.	Septic Tanks				Sewers & Secondary (IE)	12/69
Woodburn, Ind.	Septic Tanks				Sewers & Treatment facilities (I)	1977
New Haven, Ind.	Secondary	0.34	257	52	Additional sewers (E)	UN
Fort Wayne, Ind.	Secondary–S–C	21.29	35,400	3,540	Disinfection (IE) Provision of adequate dilution water or installation of advanced waste treatment (I)	1968 1977
Diversified Utilities, Inc.	Secondary	0.50	530	107	Expansion (IE)	UN
Tiffin River						
Archbold, O.	Secondary–C	1.13	4,935	145	Advanced waste treatment	NS
Bryan, O.	Secondary–C	0.92	2,390	70	Advanced waste treatment	NS
Stryker, O.	Lagoons–S	0.07	x	x	Disinfection	NS
West Unity, O.	Septic Tanks				Sewers & Advanced waste treatment (IE)	12/69/(A)
Fayette, O.	Lagoon–S–C	x	x	x	Disinfection	NS
Hudson, Mich.	Secondary	x	x	x	Expansion	NS
Addison, Mich.	Septic Tanks				Sewers & Stabilization lagoon (I)	UN
Auglaize River						
Paulding, O.	Lagoon–C	0.23	x	x	Disinfection	NS
Payne, O.	Septic Tanks				Sewers and Secondary (IE)	1968
Continental, O.	Secondary–C	0.11	155	15	Advanced waste treatment	NS
Van Wert, O.	Secondary–S–C	1.63	3,250	380	Advanced waste treatment (IE)	12/69(B)
Ohio City, O.	Septic Tanks				Sewers & Advanced waste treatment (IE)	12/68(A)
Ottawa, O.	Secondary–C	0.51	840	440	Expansion (IE)	UN
Bluffton, O.	Secondary–C	0.57	190	15	Advanced waste treatment	NS

TABLE A-3

MAUMEE RIVER AND NORTH CENTRAL OHIO AREAS (Continued)
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day) Raw	BOD (lbs./day) Final	Control Measures Needed	Abatement Schedule
Auglaize River (Cont'd.)						
Pandora, O.	Septic Tanks				Sewers & Advanced waste treatment (IE)	1/69(A)
Findlay, O.	Secondary–S–C	6.6	9,270	800	Advanced waste treatment (IE)	6/69
Dunkirk, O.	Septic Tanks				Sewers & Advanced waste treatment (I)	UN(A)
Columbus Grove, O.	Secondary–S	0.52	680	100	Advanced waste treatment (IE)	12/67(B)
Cridersville, O.	Secondary–S	x	x	x	Advanced waste treatment	NS
Lima, O.	Secondary–S–C	10.70	11,170	790	Advanced waste treatment	NS
Ada, O.	Secondary–C	0.37	430	30	Advanced waste treatment	NS
Delphos, O.	Secondary–C	1.09	1,530	165	Advanced waste treatment (IE)	9/70(B)
Spencerville, O.	Secondary–S	0.21	390	60	Expansion and Disinfection	NS
Wapakoneta, O.	Secondary–S–C	0.99	2,710	115	Advanced waste treatment	NS
Lower Maumee River						
Trilby, O.	Secondary	x	x	x	Connect to Toledo	NS
Sylvania, O.	Secondary–S	0.62	935	95	Connect to Toledo	6/67
Toledo, O.	Secondary–S–C	68.67	96,330	26,950	Advanced waste treatment (IE)	2/72(B)
Oregon, O.	Septic Tanks				Sewers & Secondary (IE)	12/69
Northwood, O.	Septic Tanks				Sewers & Connect to Toledo (IE)	UN
Walbridge, O.	Primary–S	0.05	x	x	Connect to Toledo (I)	6/67
Metropolitan SD (Holland Sub. O.)	Septic Tanks				Sewers & Advanced waste treatment (IE)	1/69(A)
Swanton, O.	Secondary–S	0.35	600	150	Advanced waste treatment	NS
Perrysburg, O.	Intermediate–C	1.02	950	430	Secondary (IE)	12/69
Haskins, O.	Primary–S	0.05	x	x	Secondary (IE)	12/69
Waterville, O.	Secondary–C	0.39	730	145	Improvements (IE)	12/69
Weston, O.	Secondary–C	x	x	x	Advanced waste treatment (IE)	UN(B)
Leipsic, O.	Secondary–C	0.39	220	25	Advanced waste treatment	NS
West Leipsic, O.	Septic Tanks				Sewers & Connect to Leipsic (IE)	UN
Delta, O.	Secondary–S	0.51	1,060	75	Advanced waste treatment	NS
Liberty Center, O.	Septic Tanks				Sewers & Advanced waste treatment	12/69(A)
Hamler, O.	Septic Tanks				Sewers & Advanced waste treatment	12/69(A)
Holgate, O.	Septic Tanks				Sewers & Advanced waste treatment (IE)	5/68(A)
Wauseon, O.	Secondary–S–C	0.69	755	80	Advanced waste treatment	NS
Defiance, O.	Intermediate–S–C	1.09	1,870	1,110	Additional sewers & Secondary (IE)	8/69
Direct to Lake Erie						
Harbor View, O.	Septic Tanks				Sewers & Connect to Oregon (IE)	12/69
NORTH CENTRAL OHIO AREA						
Portage River Basin						
Oak Harbor	Primary–S	0.65	930	640	Secondary (E)	12/69
Elmore	None				Sewers & Secondary (E)	12/69

TABLE A-3

MAUMEE RIVER AND NORTH CENTRAL OHIO AREAS (Continued)
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day)		Control Measures Needed	Abatement Schedule
			Raw	Final		
Portage River Basin (Cont'd.)						
Gibsonburg	Septic Tanks				Sewers & Advanced waste treatment	NS
Woodville	Septic Tanks				Sewers & Secondary (E)	12/69
Pemberville	Septic Tanks				Sewers & Secondary (E)	12/69
Bowling Green	Secondary–S–C	2.64	5,260	395	Advanced waste treatment	NS
Fostoria	Secondary–C	3.32	4,030	720	Advanced waste treatment	NS
North Baltimore	Secondary–C	0.27	240	75	Advanced waste treatment	NS
McComb	Primary–S–C	0.08	150	120	Advanced waste treatment (E)	12/68(A)
Bloomdale	Septic Tanks				Sewers & Advanced waste treatment (E)	12/69(A)
Sandusky River Basin						
Fremont	Secondary–C	3.09	5,580	1,080	Advanced waste treatment	NS
Bellville	Septic Tanks				Sewers & Advanced waste treatment	NS
Sandusky Co. SD 1	Septic Tanks				Sewers & Connect to Fremont (E)	1969
Clinton Twp.	Septic Tanks				Sewers & Connect to Tiffin (E)	1968
Tiffin	Primary–C	2.18	3,015	1,780	Advanced waste treatment (E)	7/68(A)
Bloomville	None				Sewers & Advanced waste treatment (E)	12/69(A)
Sycamore	Septic Tanks				Sewers & Advanced waste treatment	NS
Carey	Secondary–S	0.41	780	88	Advanced waste treatment	NS
Upper Sandusky	Secondary–S	0.77	1,700	450	Advanced waste treatment (E)	9/70(B)
Nevada	Septic Tanks				Sewers & Advanced waste treatment	NS
Bucyrus	Secondary–C	2.34	3,180	350	Advanced waste treatment	NS
Crestline	Secondary–S–C	0.48	710	30	Advanced waste treatment	NS
Attica	None				Sewers & Advanced waste treatment (E)	12/69(A)
New Washington	Septic Tanks				Sewers & Advanced waste treatment	NS
Huron River Basin						
Huron (2 plants)	Intermediate–S–C	0.78	1,150	650	Advanced waste treatment (L) (IE)	11/70(A)
Milan	Primary–S	x	x	x	Secondary (E)	UN
Monroeville	Primary–C	0.07	x	x	Secondary (E)	12/69
Norwalk	Secondary–S–C	2.25	4,310	470	Advanced waste treatment (E)	12/68(B)
Willard	Secondary–S–C	1.00	1,090	200	Advanced waste treatment	NS
Plymouth	Secondary–S	0.19	x	x	Advanced waste treatment	NS
Vermilion River Basin						
Vermilion	Primary–S	0.35	510	310	Advanced waste treatment (L) (IE)	3/69(A)
New London	Secondary–S	0.27	320	95	Advanced waste treatment	NS
Greenwich	Secondary–C	0.11	x	x	Advanced waste treatment	NS
Black River Basin						
Avon	Septic Tank & Sec.	0.09	188	87	Sewers & Connect to Metro. (E)	12/69(A)
Sheffield	Septic Tanks				Sewers & Connect to Metro.	NS
Vincent	Septic Tanks				Sewers & Connect to Lorain Metro.	NS

TABLE A–3

MAUMEE RIVER AND NORTH CENTRAL OHIO AREAS (Continued)
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day)		Control Measures Needed	Abatement Schedule
			Raw	Final		
Black River Basin (Cont'd.)						
North Ridgeville	Secondary–S	0.09	130	10	Advanced waste treatment	NS
Elyria	Secondary–S–C	6.28	9,260	1,200	Advanced waste treatment	NS
Oberlin	Secondary–S	0.70	1,535	100	Advanced waste treatment	NS
Grafton	Secondary–S	0.14	310	16	Advanced waste treatment	NS
Lagrange	Secondary–S	x	x	x	Advanced waste treatment	NS
Wellington	Secondary–S	0.18	280	32	Advanced waste treatment	NS
Lodi	Secondary–S	0.17	620	90	Advanced waste treatment	NS
Small Tributaries						
Green Springs	Primary–S–C	x	x	x	Advanced waste treatment (IE)	12/68(A)
Clyde	Secondary–S	0.59	1,215	125	Advanced waste treatment	NS
Castalia	Septic Tanks				Sewers & Advanced waste treatment	NS
Bellevue	None				Advanced waste treatment (IE)	9/69(A)
Ohio Soldiers & Sailors Home	Secondary	x	x	x	Connect to Sandusky	3/68
Perkins – Margaretta					Sandusky Metro. (IE)	
Amherst	Secondary–S	0.34	590	65	Advanced waste treatment (IE)	6/70(B)
South Amherst	Septic Tanks				Sewers & Connect to Amherst	NS
Direct to Lake Erie						
Port Clinton	Intermediate–S–C	1.45	2,435	975	Secondary (IE)	4/69
Lakeside	Intermediate	x	x	x	Secondary	NS
Marblehead	Septic Tanks				Sewers & Connect to Lakeside	NS
Kelleys Island	None				Sewers and Secondary	NS
Put-in-Bay	None				Sewers and Secondary	NS
Bay View	Septic Tanks				Sewers and Secondary	NS
Sandusky	Primary–S–C	5.2	11,270	7,450	Secondary (IE)	11/70
E. Erie Co. SD Ruggles Beach – Mittiwanga	Primary–S	0.03	x	x	Secondary (IE)	12/69
Lorain	Primary–S	10.95	16,430	8,770	Secondary (IE)	12/70
Sheffield Lake	Septic Tanks				Sewers & Connect to Metro (I)	UN
Avon Lake	Intermediate–C	1.9	3,300	2,700	Secondary (IE)	1970

TABLE A–4

MAUMEE RIVER AND NORTH CENTRAL OHIO AREA
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
MAUMEE AREA				
St. Joseph River				
Kitchen Quip	0.14	Solids xS; BOD 12.1; Phenols x; Oil x; Ni 7.2; Zn 1.5	Suspended Solids, Heavy metals (IE)	12/68
Upper Maumee River				
Weatherhead	0.28	Solids xS; BOD 33; COD 31; Phenols x; CN 2.6; Heavy metals x	Metals, Solids (IE)	9/68

TABLE A-3

MAUMEE RIVER AND NORTH CENTRAL OHIO AREAS (Continued)
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day)		Control Measures Needed	Abatement Schedule
			Raw	Final		
Black River Basin (Cont'd.)						
North Ridgeville	Secondary–S	0.09	130	10	Advanced waste treatment	NS
Elyria	Secondary–S–C	6.28	9,260	1,200	Advanced waste treatment	NS
Oberlin	Secondary–S	0.70	1,535	100	Advanced waste treatment	NS
Grafton	Secondary–S	0.14	310	16	Advanced waste treatment	NS
Lagrange	Secondary–S	x	x	x	Advanced waste treatment	NS
Wellington	Secondary–S	0.18	280	32	Advanced waste treatment	NS
Lodi	Secondary–S	0.17	620	90	Advanced waste treatment	NS
Small Tributaries						
Green Springs	Primary–S–C	x	x	x	Advanced waste treatment (IE)	12/68(A)
Clyde	Secondary–S	0.59	1,215	125	Advanced waste treatment	NS
Castalia	Septic Tanks				Sewers & Advanced waste treatment	NS
Bellevue	None				Advanced waste treatment (IE)	9/69(A)
Ohio Soldiers & Sailors Home	Secondary	x	x	x	Connect to Sandusky	3/68
Perkins – Margaretta					Sandusky Metro. (IE)	
Amherst	Secondary–S	0.34	590	65	Advanced waste treatment (IE)	6/70(B)
South Amherst	Septic Tanks				Sewers & Connect to Amherst	NS
Direct to Lake Erie						
Port Clinton	Intermediate–S–C	1.45	2,435	975	Secondary (IE)	4/69
Lakeside	Intermediate	x	x	x	Secondary	NS
Marblehead	Septic Tanks				Sewers & Connect to Lakeside	NS
Kelleys Island	None				Sewers and Secondary	NS
Put-in-Bay	None				Sewers and Secondary	NS
Bay View	Septic Tanks				Sewers and Secondary	NS
Sandusky	Primary–S–C	5.2	11,270	7,450	Secondary (IE)	11/70
E. Erie Co. SD Ruggles Beach – Mittiwanga	Primary–S	0.03	x	x	Secondary (IE)	12/69
Lorain	Primary–S	10.95	16,430	8,770	Secondary (IE)	12/70
Sheffield Lake	Septic Tanks				Sewers & Connect to Metro (I)	UN
Avon Lake	Intermediate–C	1.9	3,300	2,700	Secondary (IE)	1970

TABLE A-4

MAUMEE RIVER AND NORTH CENTRAL OHIO AREA
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
MAUMEE AREA				
St. Joseph River				
Kitchen Quip	0.14	Solids xS; BOD 12.1; Phenols x; Oil x; Ni 7.2; Zn 1.5	Suspended Solids, Heavy metals (IE)	12/68
Upper Maumee River				
Weatherhead	0.28	Solids xS; BOD 33; COD 31; Phenols x; CN 2.6; Heavy metals x	Metals, Solids (IE)	9/68

TABLE A-4

MAUMEE RIVER AND NORTH CENTRAL OHIO AREAS (Continued)
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
Upper Maumee River (Cont'd.)				
Parrot Packing	0.09	Solids xS; BOD 884; COD 730; Oil 136	BOD, Grease, Suspended Solids (IE)	12/68
International Harvester	x	Solids xS; BOD x; Cyanide x	BOD, Suspended Solids (IE)	12/68
Franke Plating	0.12	Solids xS; BOD 7.1; CN 38.0 COD 117; Zn 0.7; Cu 1.7; Ni 2.0; Cd 4.6	Cyanide, Heavy metals Suspended Solids (IE)	1968
General Plating	x	Solids xS; Heavy metals x; Cyanide x	Cyanide, Heavy metals Suspended Solids (IE)	12/68
Universal Tool	x	Zn x	Zn (IE)	1968
Tiffin River				
Hudson Plating	x	x	Additional treatment	NS
Rima Mfg.	x	x	BOD	NS
M & S Mfg.	x	x	Additional treatment	NS
Hudson Metal Products	x	x	Establish adequacy of treatment	NS
Auglaize River				
Rusco	0.06	Solids xS; Oil 16.8; COD 30.9; Mg 13.5; Si 36.8; pH x	Neutralization, Solids (IE)	8/68
Sohio Chemical Co. (Now Vistron)	1.93	Solids 14,600T; BOD 140; NH_3 400; COD 1,300;	Nitrogen compounds (IE)	1/68
Sohio Chemical – Petrochemicals	0.85	Solids xT; BOD 70; Phenols 440; NH_3 1,800; COD 1,050; CN 75	Nitrogen compounds, Oxygen Demand (IE)	1/69
Republic Creosote	0.01	BOD 26; Phenols 7.7; Oil 19; COD 12.7	Phenols, Oil	1/69
Pepsi-Cola Bottling	x	BOD x	Oxygen Demand (IE)	1/68
Walter & Son	x	BOD x	Evaluate existing facilities (IE)	UN
Lower Maumee River				
Interlake Steel	44.0	Solids xS; BOD x; COD x; Phenols x; Temp. x	Solids (IE)	8/69
Libby-Owens-Ford	0.25	Solids xS	Solids (IE)	1/69
Doehler-Jarvis – Div. National Lead	x	Solids xS; Heavy metals x; Cyanide x	Metals, Solids, Cyanide (IE)	6/68
Toledo Scale	x	Solids xS; Heavy metals x; Oil x	Connect to city sewers (IE)	7/68
Hirzel Canning	x	BOD x	BOD	8/68
Standard Oil (H)	39.8	Solids 184,000T; pH 6.9-9.1; Solids 151,000D; BOD 8,810; COD 25,000; Phenols 270; NH_3 1,100; Oil 10,600; Temp. 78	Oil, Solids, Phenols, Oxygen Demand (IE)	12/69
Gulf Oil	68.4	COD 8,200; BOD 4,300; Phenols 35; Oil 1,260	COD, Oils, Phenols	NS
Sun Oil	1.8	COD 4,400; BOD 1,000; Oil 440	COD, Oils	NS
Clevite, Harris Div. Napoleon	x	Oil x; Solids xS; pH x; Heavy Metals x	Solids, Metals, pH (IE)	7/68
Elite Plating Div. Dynavest	x	Oil x; Solids xS; CN x; Heavy Metals x	Metals, Cyanide, pH (E)	7/68
Campbell Soup	0.8	Solids 180S; COD 1,600; Boron 280; BOD 1,230; Oil x; Temp. x	Solids, Oxygen Demand (IE)	7/69

TABLE A-4

MAUMEE RIVER AND NORTH CENTRAL OHIO AREAS (Continued)
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
Lower Maumee River (Cont'd.)				
Central Foundry – GMC	4.0	BODx; COD x; Phenols x; Oil x; Temp. x	Solids	7/67
S. K. Wayne Tool	x	Oil x; pH x; Heavy metals x	Metals, neutralization (IE)	1/68
NORTH CENTRAL OHIO AREA				
Portage River Basin				
Hirzel Canning	x	BOD x; Solids xS	Improve operations (IE)	8/67
Foster Duck Farm	x	BOD x	BOD	NS
Swift	x	BOD x; Solids xS; Oil x	Oil, Color, BOD (E)	6/67
Seneca Wire	1	Fe 1,470; pH 2.0–7.0; Solids xS	Iron, Acids, Solids (E)	1/69
Sandusky River Basin				
Northern Ohio Sugar	x	BOD 870; pH 7.3–8.5	BOD (E)	12/69
Pioneer Rubber	.03 (est)	COD x	COD	UN
Pennsylvania RR	x	Oil x	Oil	NS
Huron River Basin				
Clevite – Harris Div.	x	Solids xS; Chrome x	Chrome, Solids (E)	7/68
Baltimore & Ohio RR	x	Oil x	Oil (E)	7/68
Black River Basin				
U. S. Steel – Tubular Operations	170	Oil 11,000; Solids 91,000S; Phenols 60; pH 7.2–8.5	Solids, Oil, Phenols, Fe (E)	12/69
General Motors – Turnstedt Div.	2	Chrome 570; Nickel 480; Copper 140; Cyanide 3	Metals (E)	11/67
Republic Steel – Steel & Tubes Div.	5 (est)	pH x	Acid (E)	12/69
Baldwin Producing	x	Oil x	Oil	NS
Berea Oil	x	Oil x	Oil	NS
C & B Oil	x	Oil x	Oil	NS
Chatham Operating	x	Oil x	Oil	NS
Dymo Oil	x	Oil x	Oil	NS
Preston Oil	x	Oil x	Oil	NS
Small Tributaries				
Norfolk & Western RR	x	Oil x	Oil (IE)	6/68
Bechtel-McLaughlin	.06	pH 3.1–5.6; Cu 5; Zn 6; Cr 27; CN 2; Solids x	Acid, Chrome, Solids (IE)	2/68
G. E. Lamp Plant #242	x	BOD x	BOD (IE)	9/69
Central Soya	x	Oil x	Oil (IE)	6/68
Direct to Lake Erie				
U. S. Gypsum	0.9	BOD x; pH 4.1–7.9; Temp. x; Solids 3,300S	Solids and BOD (IE)	12/69
Ohio Edison	121	pH 6.8–8.6; Solids xS	Solids (I)	UN
Cleveland Electric Illuminating	350	Solids 17,000S	Solids (IE)	7/68

TABLE A–5

GREATER CLEVELAND-AKRON AND NORTHEAST OHIO AREAS MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day) Raw	BOD (lbs./day) Final	Control Measures Needed	Abatement Schedule
GREATER CLEVELAND–AKRON AREA						
Rocky River Basin						
Lakewood	Secondary–S–C	15.0	14,500	1,500	Extend outfall to Lake Erie.	NS
Westlake	Septic Tanks				Sewers and connect to county sewer district (IE)	UN
Brook Park	Secondary–S	0.86	1,430	140	Connect to Metro or Advanced Waste Treatment	NS
North Olmsted	Secondary–S	2.69	6,270	520	Connect to Metro or Advanced Waste Treatment	NS
Olmsted Falls	Septic Tanks				Sewers and connect to Metro or Advanced Waste treatment (E)	UN(A)
Berea	Secondary–S	2.40	2,740	620	Connect to Metro or Advanced Waste Treatment (E)	6/69(B)
Westview	Septic Tanks				Sewers and connect to Metro or Advanced Waste Treatment (E)	12/68(A)
Strongsville	Secondary–S	x	x	x	Connect to Metro or Advanced Waste Treatment	NS
North Royalton County Dists.	Secondary–S	x	x	x	Connect to Metro or Advanced Waste Treatment (E)	UN(B)
Breezewood	Secondary	x	x	x	Connect to Metro or Advanced Waste Treatment	NS
Middleburg Hts.	Secondary–S	0.4	550	430	Connect to Metro or Advanced Waste Treatment (E)	12/68(B)
Brunswick SD 100	Secondary–S	0.80	x	53	Advanced Waste Treatment	NS
Medina Sd 5	Secondary	0.13	230	20	Advanced Waste Treatment	NS
Medina SD 100	Secondary	0.92	1,380	40	Advanced Waste Treatment	NS
Medina	Secondary–S	1.25	2,900	380	Advanced Waste Treatment	NS
Cuyahoga River Basin						
Cleveland Southerly	Secondary–S–C	62.6	49,600	4,000	Advanced Waste Treatment (IE)	12/69(B)
Maple Heights	Secondary–S	0.7	2,800	1,050	Connect to Metro or Advanced Waste Treatment	NS
Independence	Septic Tanks				Sewers & connect to Metro or Advanced Waste Treatment (E)	12/69(A)
Valley View	Septic Tanks				Sewers and connect to Metro or Advanced Waste Treatment	NS
Bedford	Secondary–S–C	2.17	3,040	560	Connect to Metro or Advanced Waste Treatment	NS
Bedford Heights	Secondary–S–C	1.50	1,690	710	Connect to Metro or Advanced Waste Treatment	NS
Solon	Secondary–S	0.71	1,400	120	Connect to Metro or Advanced Waste Treatment	NS
Oakwood	Secondary–S	x	x	x	Additional sewers and connect to Metro or Advanced Waste Treatment	NS
Broadview Heights	Septic Tanks				Sewers and connect to Metro or Advanced Waste Treatment	NS
Twinsburg	Secondary–S	0.39	670	50	Connect to Metro or Advanced Waste Treatment	NS
Northfield	Secondary–S	0.37	790	60	Connect to Metro or Advanced Waste Treatment	NS

TABLE A-5

GREATER CLEVELAND–AKRON AND NORTHEAST OHIO AREAS (Continued)
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day) Raw	BOD (lbs./day) Final	Control Measures Needed	Abatement Schedule
Cuyahoga River Basin (Cont'd.)						
Sagamore Hills	Septic Tanks				Sewers and connect to Metro or Advanced Waste Treatment	NS
Akron	Secondary–S–C	68.6	75,700	27,500	Advanced Waste Treatment (E) including nitrogen removal	1970(B)
Hudson	Secondary–S	0.45	980	190	Advanced Waste Treatment	NS
Cuyahoga Falls	Secondary–S	0.04	140	4	Connect to Metro or Advanced Waste Treatment	NS
Sawyerwood	Septic Tanks				Sewers & connect to Metro or Advanced Waste Treatment	NS
Munroe Falls	Septic Tanks				Sewers & connect to Metro (E)	UN
Tallmadge	Secondary–S	0.13	x	14	Connect to Metro or Advanced Waste Treatment	NS
Kent	Secondary–S	1.30	2,960	180	Connect to Metro or Advanced Waste Treatment	NS
Ravenna	Secondary–S	1.03	1,450	200	Connect to Metro or Advanced Waste Treatment	NS
Middlefield	Primary–C	0.33	x	180	Secondary (E)	8/68
County Districts						
Seven Hills SD 2	Secondary	0.03	354	20	Connect to Metro or Advanced Waste Treatment	NS
Walton Hills SD 20	Secondary–S	0.24	250	40	Connect to Metro or Advanced Waste Treatment	NS
Brecksville SD 13	Secondary–S–C	0.77	1,450	130	Connect to Metro or Advanced Waste Treatment	UN
Northeast SD 1	Secondary–S	0.07	120	10	Connect to Metro or Advanced Waste Treatment	NS
Northeast SD 6	Secondary–S	0.43	630	150	Connect to Metro or Advanced Waste Treatment	NS
Northeast SD 15	Secondary–S	1.04	890	140	Connect to Metro or Advanced Waste Treatment	NS
Stow Twp. SD 4	Primary–S	1.10	1,870	1,360	Additional Sewers and Connect to Metro or Advanced Waste Treatment (E)	UN(A)
Chagrin River Basin						
Gates Mills	Septic Tanks				Sewers & Advanced Waste Treatment	NS
Pepper Pike	Secondary–S	x	500	50	Connect to Metro or Advanced Waste Treatment	NS
Aurora	Secondary–S	0.32	330	30	Advanced Waste Treatment (E)	10/69(B)
Chagrin Falls	Secondary–S	0.42	590	70	Advanced Waste Treatment	NS
County Districts						
Chester Twp. SD 1 & 2	Secondary	x	100	10	Advanced Waste Treatment	NS
Direct to Lake Erie						
Rocky River SD 6	Intermediate–S	4.76	6,190	4,080	Secondary (IE)	9/69
Cleveland Westerly	Primary–S–C	34.1	46,830	38,330	Secondary (IE)	12/71
Cleveland Easterly	Secondary–S–C	122.0	109,000	23,400	Expansion (IE)	9/70
Euclid	Intermediate–S	14.60	23,900	10,100	Secondary (IE)	6/70
Willoughby – Eastlake	Intermediate–S	2.90	2,290	1,535	Secondary (IE)	7/70

TABLE A-5

GREATER CLEVELAND--AKRON AND NORTHEAST OHIO AREAS (Continued)
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day) Raw	BOD (lbs./day) Final	Control Measures Needed	Abatement Schedule
NORTHEAST OHIO AREA						
Grand River Basin						
Fairport Harbor	Intermediate–S	0.32	450	320	Secondary (IE)	10/70
Grand River	Septic Tanks				Sewers & Connect to Metro (IE)	12/69(A)
Painesville	Primary–S	2.51	4,320	2,050	Connect to Metro (IE)	12/70(A)
Chardon	Secondary–S	0.49	510	100	Expansion & Disinfection	NS
Jefferson	Secondary–S	0.57	600	130	Expansion & Disinfection	NS
Orwell	Septic Tanks				Sewers & Secondary (E)	11/68
Conneaut Creek Basin						
Conneaut	Intermediate–S	2.4	2,360	1,640	Secondary & additional sewers (in area formerly known as Lakeville) (IE)	10/69
Springboro, Pa.	None				Sewers and Secondary (I)	UN
Conneautville, Pa.	None				Sewers and Secondary (I)	UN
Small Tributaries						
North Kingsville	Septic Tanks				Sewers and Secondary	NS
Direct to Lake Erie						
Lake County SD Willoughby–Mentor	Intermediate–S	1.82	2,520	810	Secondary (IE)	1/71
Lake County SD 1 Madison	Primary–S	1.14	540	540	Secondary (IE)	1/71
Geneva-on-the-Lake	Primary–S	x	x	x	Secondary (IE)	12/69
Ashtabula	Intermediate–S	5.0	5,845	4,010	Secondary (IE)	10/70

TABLE A-6

GREATER CLEVELAND–AKRON AND NORTHEAST OHIO AREAS
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
Rocky River Basin				
Farm Packt Pickle	x	BOD x; Cl x; Solids xS	Solids, BOD, Chlorides	UN
Cuyahoga River Basin				
Republic Steel	290	Solids xT; Solids 180,000S; SO_4 120,000(G); Cl 32,000 (G); Phenol 280; CN 400; NH_3 4,100; Mg 1,000; Fe 12,000; Temp. 10° F; pH x; COD x; Oil x; Heavy metals x	Solids, Iron, Oil, Ammonia Acid, Phenols, Cyanides, Heavy metals (E)	12/69

TABLE A-6

GREATER CLEVELAND–AKRON AND NORTHEAST OHIO AREAS (Continued)
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
Cuyahoga River Basin (Cont'd.)				
U. S. Steel	23.5	Solids 84,000T; Solids 30,000S; Oil 510; Temp. x; SO_4 50,000; Cl 1,000; Fe 15,000, pH x	Solids, Iron, Oil, Acids (E)	12/69
Jones & Laughlin	130	Solids xT; Solids 10,400S; pH x; COD x; Oil 1,200; Temp. x; SO_4 12,200; Fe 6,600; Cl 4,900	Solids, Iron, Oil (E)	12/69
Harshaw Chemical	1.4	pH 1.0–8.7; F 550; Ni 160; Ca x; SO_4 x; Cl 3,100; Mn 30; Solids x	Solids, Fluorides, Nickel (E)	12/68
Research Refining	x	Oil x	Oil	NS
Astoria Plating	x	Oil x; CN x; Cu x; Cr x; Cd x; Ni x; Solids xT; pH x; COD x	Cyanides, Oil, pH, Heavy metals, Color (E)	1/68
Cuyahoga Meat	x	Solids xS; BOD x	BOD (E)	6/68
Ford Motor – Engine Plant	0.9	Solids xT; Solids 62S; pH 6.5–9.5; Oil 62; Temp. x	Oil	NS
Modern Tool & Die	x	Oil x; Grease x	Oil, Grease	9/69
Bedford Gear	x	Oil x	Oil	UN
Morce	x	Oil x	Oil	10/69
Tecumseh Corrugated Box, Jaite Mill Div.	x	Solids x; BOD x	Solids, BOD	7/68
Ohio Edison Gorge Plant	x	Solids xS; Temp x	Temperature	NS
Consolidated Freightways	x	Solids xS; pH x; Oil x; Organics x	Solids, Oils, Organics	UN
Lerkis Asphalt	x	Solids xS; pH x; Fe x	Solids, Acid, Iron	4/68
B. F. Goodrich	x	Solids xT; COD x; Temp. x; Organics; Oil x	Solids, Organics, COD, Oil (E)	1/69
Firestone Tire & Rubber	x	Solids xT; COD x; Temp. x; Organics; Oil x	Solids, Organics, COD, Oil (E)	1/69
Diamond Crystal Salt	x	Temp. x; Cl x; Solids xT	Solids, Chlorides (E)	1/68
Goodyear Tire	x	Solids xT; COD x; Oil x; Organics x; Temp. x	Solids, Organics, COD, Oil (E)	1/69
Goodyear Aerospace	x	Solids xT; CN x; Cr x; Cu x; Zn x; SO_4 x; Cd x; pH x; COD x; Oil x	Solids, heavy metals, Cyanides (E)	6/68

TABLE A–6

GREATER CLEVELAND–AKRON AND NORTHEAST OHIO AREAS (Continued) MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
Cuyahoga River Basin (Cont'd.)				
M & M Sand & Gravel	x	Solids xS	Solids	UN
Cornwell Tools	.01	Solids xT; Cr x; Zn x	Heavy metals	NS
Sonoco Products	.57	Solids 300S; BOD 782; Temp. 64° F	Solids, BOD (E)	1/69
Lamson & Sessions	.03	Solids 8.5(J); Oil x; SO_4 x	Solids, Oil	NS
Chagrin River Basin				
Chase Bag	1	Solids xT; Solids 770S; pH 5.9–7.6; BOD x; COD x; Temp. 62° F	Color, Solids, BOD (E)	12/69
Custom Beverage Packers	2	Solids x; BOD x	BOD	10/68
Mulberry Sand & Gravel	x	Solids xS	Solids	UN
Direct to Lake Erie				
Cleveland Electric Illuminating Co.				
Eastlake Plant	520	Solids 35,000S; Temp. x	Solids (IE)	4/68
Lakeshore Plant	450	Solids 5,300S; Temp. x	Solids (IE)	10/68
TRW	x	Solids x; Metals x	Improve treatment facilities for all constituents (IE)	1/69
NORTHEAST OHIO AREA				
Grand River Basin				
Calhio	0.2	Solids 36,000T; Solids xD; Cl 11,000; pH x	Solids, Chlorides	NS
A. E. Staley	x	Solids xT; Solids xD; pH x; BOD x- Oil x	Connect to Metro	12/68(B)
Diamond Shamrock (discharging also direct to Lake Erie)	5.3	Solids 6,500,000D; Cl3,900,000; Solids 160,000S; NH_3 3,400; Phenols 21	Chlorides, Solids (IE)	6/68
U. S. Rubber–Uniroyal	0.3	Solids 1,880T; Solids 518S; COD x; pH x; Cl x	Solids, pH, COD (IE)	12/69
Allied Chemical Plastics Div. Painesville Plant	x	Solids xS; COD x	Solids	NS
Chardon Rubber, Div. Ball Bros. Co. Inc.	x	Oil x; Solids xS	Oil, Solids	UN
Glenn Sand & Gravel	x	Solids xS	Solids	UN
Welded Tubes, Inc.	x	BOD x	Connect to Metro	NS
Ashtabula River Basin				
Detrex Chemical – Chlorinated Solvents Div.	0.1	Solids 1,800T; Solids 1,700D Chlorides 2,400; Fe 41	Odor, Color (IE)	UN

TABLE A–6

GREATER CLEVELAND–AKRON AND NORTHEAST OHIO AREAS (Continued)
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
Ashtabula River Basin (Cont'd.)				
General Tire & Rubber-Chemical Div.	0.1	Solids 680T; Solids 12S; Chlorides 250; pH 6.9–8.3	Improved neutralization and solids removel; control of spills (IE)	1/69
Olin Mathieson – TDI Plant	4	Data not available for public release	Improved neutralization and solids control; in-plant controls and acid recovery; Color (IE)	UN
Reactive Metals – Metals Reduction	1.3	Data not available for public release	Suspended and dissolved solids (IE)	12/68
Diamond Alkali – Semi-Works	0.6	COD 425; Solids xT; Organics x	Needs evaluation	NS

In addition to the above individual needs, all industries in the Ashtabula complex that discharge to Fields Brook should jointly develop a solution to treat the combined wastes after discharge.

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
Direct to Lake Erie				
Diamond Shamrock (discharge also to Grand River)	10	Solids 37,000D; Solids 6,200S Chlorides 26,000; Ammonia 710; Phenols 17	Settling (IE)	6/68
Midland Ross – IRC Fibers	29	Solids 274,000T; Chlorides 40,000; Solids 254,000D; pH 2.8–3.8; BOD 8,700; Oil 4,300; Zn 6,700	Terminal treatment (IE)	1/69
Cleveland Electric Illuminating Ashtabula Plant	3	Solids 1,200S; Temp. x	Solids (IE)	12/68

TABLE A–7

PENNSYLVANIA AND NEW YORK AREAS
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day) Raw	BOD (lbs./day) Final	Control Measures Needed	Abatement Schedule
PENNSYLVANIA AREA						
Small Tributaries						
Lake City	Secondary–S	0.4	868	227	Extend outfall to Lake Erie	NS
Girard	Intermediate – S	0.5	1,135	138	Secondary (E)	8/68
Direct to Lake Erie						
Erie	Secondary – S – C	40	57,450	6,680	Expansion	12/70

TABLE A-7

PENNSYLVANIA AND NEW YORK AREAS (Continued)
MAJOR MUNICIPAL WASTE PROBLEMS

Municipality	Type Sewerage System	Flow (mgd)	BOD (lbs./day) Raw	BOD (lbs./day) Final	Control Measures Needed	Abatement Schedule
NEW YORK AREA						
Buffalo River Basin						
West Seneca SD 6	Primary – S	0.2	194	137	Connect to Metro or Advanced Waste Treatment (I)	8/71(A)
Cheektowaga SD 3	Secondary – S	1.4	2,770	864	Connect to Metro or Advanced Waste Treatment (I)	4/72(B)
Depew (V) SD 1	Primary–S	1.8	2,880	720	Connect to Metro or Advanced Waste Treatment (IE)	1/1/70(A)
Lancaster	Secondary–S	0.9	x	x	Connect to Metro or Advanced Waste Treatment (E) (I)	6/1/68(B) 6/1/69(B)
East Aurora (V)	Secondary–S	1.1	1,180	220	Advanced Waste Treatment	NS
Holland (T)	Septic Tanks				Sewers and Advanced Waste Treatment	NS
Eighteenmile Creek and Cattaraugus Creek Basins						
Erie Co. SD 2 North Plant	Primary–S	0.3	100	60	Advanced Waste Treatment	NS
Eden	Septic Tanks				Sewers & Advanced Waste Treatment	NS
Hamburg (V)	Secondary–S	1.0	1,320	275	Advanced Waste Treatment	NS
Gowanda State Hospital	Primary–S	0.4	x	x	Secondary	NS
Gowanda	Primary–S	0.7	690	560	Advanced Waste Treatment	NS
Springville	Primary–S	0.5	745	370	Secondary	NS
Arcade	Secondary–S	0.3	443	60	Advanced Waste Treatment	NS
Small Tributaries						
Lackawanna	Primary–S–C	3.1	4,500	2,450	Connect to Metro or Secondary (I)	4/72(A)
Blasdell	Secondary–S	0.8	2,040	160	Connect to Metro	NS
Woodlawn	Secondary–S	0.4	x	x	Connect to Metro (I)	4/72(A)
Derby	Septic Tanks				Sewers & Secondary with Outfall to Lake Erie	NS
Angola	Septic Tanks				Sewers & Advanced Waste Treatment (L)	NS
Erie Co. SD 2 South Plant	Primary–S	0.6	140	90	Secondary	NS
North Collins (V)	Secondary–S	0.2	242	117	Advanced Waste Treatment (E)	3/70(B)
Silver Creek	Secondary–S	x	x	x	Extend Outfall to Lake Erie	NS
Fredonia (V)	Secondary–S–C	2.0	3,870	1,000	Connect to Dunkirk or Advanced Waste Treatment (IE)	1/71(B)
Brocton	Septic Tanks				Sewers & Advanced Waste Treatment (L) (IE)	6/69(A)
Westfield	Secondary–S	0.9	1,800	1,090	Advanced Waste Treatment (L) (IE)	12/69(B)
Direct to Lake Erie						
Mt. Vernon	Primary–S	0.3	390	247	Secondary (I)	1/71
Wanakah	Primary–S	0.25	475	258	Secondary (I)	4/72
Hamburg (T)	Primary–S	1.9	1,490	411	Secondary (I)	4/72
Dunkirk	Primary–S–C	4.3	8,070	4,520	Secondary (IE)	12/69
Ripley SD	Primary–S	0.1	3,100	940	Secondary (IE)	4/72

TABLE A-8

PENNSYLVANIA AND NEW YORK AREAS MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
PENNSYLVANIA AREA				
Small Tributaries				
Gunnison Bros.	0.002	BOD 6; Solids 100T; Solids 20S	Secondary	5/68
Brown Slaughter	x	BOD x; Grease x; Solids xS	Secondary	NS
Specialty Valve and Control	x	Oil x	Oil	NS
Direct to Lake Erie				
Hammermill	20	BOD 62,000; Solids 530,000T; Solids 84,000S; SO_4 51,000	BOD, Color, Odor (IE)	12/70
Erie Reduction	0.2	BOD 10; Solids x	BOD (E)	3/68
NEW YORK AREA				
Buffalo River Basin				
General Mills	x	BOD x; Solids xS	Connect to Metro or Secondary	NS
Pillsbury Mills	x	BOD x; Solids xS	Connect to Metro or Secondary	NS
Perot Malting	x	BOD x; Solids x	Connect to Metro or Secondary	NS
Allied Chemical Buffalo Dye	14.8	BOD 31,300; Solids 14,000S; pH 2.5–4.0; COD 80,000; Chlorides 96,000; Cyanide 12; Iron 7,400; Phenol 150	Color, Solids, BOD, Acid, Phenols (IE)	1/71
Republic Steel	26.5	Solids 16,000S; pH 3.7–9.5; COD 73,000; Oil 9,900; Iron 16,000	Oils, Solids, Color, Acid, Iron (IE)	7/71
Donner Hanna Coke	6.0	COD 2,500; Oil 780; Phenols 120	Oil, Phenols, BOD (IE)	12/69
Mobil Oil	22.5	BOD 3,700; Solids 25,000T, Solids 2,600S; pH 7.4–8.0; COD 4,700; Oil 1,500; Chlorides 2,500; Phenol 380	Oil, Phenols (IE)	12/69 Plans to discontinue refinery 6/68
Symington Wayne	x	BOD x; pH x; Oil x	Oil, BOD, Color	NS
Pennsylvania Railroad Shops	x	Oils x; pH x	Oil	1/68
Cattaraugus Creek Basin				
Silver Creek Preserving			Solids, Color, Oil & Connect to Silver Creek (E)	UN
Peter Cooper Eastern Tanners and Glue	3.6	BOD 26,000; Solids 131,000T, Solids 9,600S	Advanced Waste Treatment, Ammonia, Grease, Chrome (IE)	1/70
Moench Tannery	1.7	BOD 8,700; Solids 90,000T, Solids 7,600S	Advanced Waste Treatment, Ammonia, Grease, Chrome	1/71
Small Tributaries				
Welch Grape Juice (Westfield)	0.5	BOD x; Solids xS	Connect to city sewers (IE)	12/69
Growers Coop. Grape (Westfield)	x	BOD x; Solids xS	Connect to city sewers (IE)	12/69
Direct to Lake Erie				
Hanna Furnace	26	Solids xS; Oil x	Solids (IE)	4/72
Bethlehem Steel	350	BOD 5,200; Solids 350,000S; pH 4.0–7.0; COD 11,000; Oil 31,000; Phenols 680; Cyanide 950	Oil, Phenols, Solids, Color, Cyanides, Ammonia, Acid, Iron (IE)	1/70

TABLE A–8

PENNSYLVANIA AND NEW YORK AREAS (Concluded)
MAJOR INDUSTRIAL WASTE PROBLEMS

Industry	Flow (mgd)	Waste Constituents (lbs./day)	Control Measures Needed	Abatement Schedule
Direct to Lake Erie (Cont'd.)				
Allegheny–Ludlum	1.5	Solids xS; pH x; Oil x; Temp. x; Iron x	Solids, Oil, Acid (IE)	1/69
Seneca Westfield Maid	0.5	BOD x; Solids xS	Connect to city sewers (IE)	12/69

GPO [illegible]

RECEIVED
NATIONAL TECHNICAL
JAN 0 4 1973
INFORMATION SERVICE

Mother dear may I go out to swim.
Yes my darling daughter.
Hang your clothes on a hickory limb,
But don't go near the water.

Anonymous